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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 1994

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Departments of Veterans Affairs and...

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BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

SUBCOMMITTEE ON VA, HUD, AND INDEPENDENT AGENCIES

LOUIS STOKES, Ohio, *Chairman*

ALAN B. MOLLOHAN, West Virginia
JIM CHAPMAN, Texas
MARCY KAPTUR, Ohio
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RICHARD N. MALOW, PAUL E. THOMSON, MICHELLE M. BURKETT, and DANIEL A. CANTU,
Staff Assistants

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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 1994

HEARINGS

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U.S. GOVERNMENT PRINTING OFFICE

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WASHINGTON : 1993

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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 1994

FRIDAY, MARCH 26, 1993.

NATIONAL SCIENCE FOUNDATION

WITNESSES

WALTER E. MASSEY, DIRECTOR
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JOSEPH KULL, CHIEF FINANCIAL OFFICER AND DIRECTOR, OFFICE OF BUDGET, FINANCE AND AWARD MANAGEMENT
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LINDA SUNDRO, INSPECTOR GENERAL
RAYMOND E. BYE, JR., DIRECTOR, OFFICE OF LEGISLATIVE AND PUBLIC AFFAIRS
LARRY RUDOLPH, ACTING GENERAL COUNSEL

Opening Remarks of Mr. Stokes

Mr. STOKES. The committee will come to order.

Dr. Massey, we welcome you back before our subcommittee. It is a pleasure to have you here again. I am going to make some brief opening remarks, after which I will ask you to introduce your associates and then we will receive your opening statement.

Dr. Massey, you are requesting a 1994 appropriation of $3,180,200,000 for the National Science Foundation. That represents an increase of $446 million above the 1993 enacted level, and $240 million above the 1993 revised plan. That of course is including the enactment of 1993 economic stimulus supplemental appropriation.

I believe that bill was passed by the Senate last night. I am sorry, just the budget.

I want to make just one observation about the National Science Foundation appropriation in the economic stimulus bill. In some ways, the inclusion of that substantial amount of money, regardless of how meritorious it may be, has distorted the committee's approach to meeting the extremely tight outlay allocation imposed last year.

That approach, as you know, was simply to fund all major agencies and most of the smaller agencies at the same level as provided in 1992, except for VA medical care which the committee gave the highest priority, We funded at the President's 1993 request.

The point I guess we want to bring out is that, if we had had an additional $206 million available during the time we went to conference on the 1993 appropriation bill, we probably would not have used all of that money for programs of the National Science Foundation.

We make these comments because if the economic stimulus bill becomes law, and coupled with the additional $240 million increase requested in the budget that we are holding hearings on today, the NSF would receive an increase in 1994 over 1993 that is, on a percentage basis, significantly higher than any other agency in this bill.

So we stress this point in the context of what our 1994 allocation turns out to be. If the subcommittee's allocation is sufficiently generous to cover most of the President's requested increase, we would then place high priority on the Foundation's activities. But if that allocation does not mirror the President's request for this subcommittee and the economic stimulus bill is enacted, then we will probably have to take into account the rather substantial additional monies provided in the stimulus package for the National Science Foundation as we look at 1994.

One other matter that I wanted to call to your attention is that the justifications for your agency was not delivered until the close of business on Tuesday. That made it a little difficult for the staff in preparing for this hearing. But I know you will help us as we go along here in light of the that fact.

At this time, then, I would like to once again welcome you and afford you the opportunity at this time to present to us your associates who are accompanying you and we will proceed with your presentation.

INTRODUCTION OF ASSOCIATES

Dr. MASSEY. Thank you very much, Mr. Chairman. It is a pleasure for me to be here today to present the NSF's 1994 request. I would like to introduce members of the staff who are here who will be helping me to respond to your questions. First of all, Dr. Fred Bernthal, the Deputy Director of the agency; Dr. Mary Clutter, Assistant Director for Biological Sciences; Nico Habermann, the Assistant Director for Computer and Information Science and Engineering; Joe Bordogna, the Assistant Director for Engineering;

Luther Williams, who is Assistant Director for Education and Human Resources; Robert Corell for the Geosciences; Bill Harris for Mathematical and Physical Sciences is here; and Dr. Cora Marrett for Social, Behavioral and Economic Sciences; and also Mr. Joe Kull, who is the Chief Financial Officer; and Ray Bye, who you know, is Director of the Office of Legislative Affairs.

We also have with us today a member of the National Science Board, Dr. Roland Schmitt, who is the President of Rensselaer Polytechnic Institute. And if it meets with your approval, I would like to have Dr. Schmitt say a few words before I present my testimony.

Mr. STOKES. We will be pleased to recognize Dr. Schmitt also and we welcome all of the associates.

STATEMENT FROM DR. SCHMITT

Dr. SCHMITT. Thank you very much, Mr. Chairman. And other members of the subcommittee. It is really a great pleasure for me to be here today on behalf of the National Science Board regarding the National Science Foundation's budget request for the fiscal year 1994. I should tell you from the perspective of the Board, this proposed budget provides really an excellent opportunity to invest in the Nation's research and education enterprise, a very important part of our society and to enhance our overall capabilities in science and technology.

It builds very strongly on the momentum that was generated by the works of the Commission on the future of the National Science Foundation, whose report was issued recently, and by the Foundation's own internal planning process.

If I may, I would like to relate that the recommendation of the Commission, one very prominent recommendation of that Commission was that NSF strike a systematic balance between its fundamental curiosity-driven research activities and research in strategic areas of national priority.

Now, I would like to relate that to findings of a National Science Board Committee on Industrial R&D which I cochaired which was issued last August. We pointed out in that report that entirely new industries, entirely new high-quality jobs are created by pioneering kinds of research and pioneering kinds of adventure. Whole industries, like microelectronics, computer biotechnology, come out of that kind of research.

The strategic areas of science technology are areas in which we believe there are opportunities for these pioneering advances. Moreover, the curiosity-driven research initiated by scientists themselves will often be in these fields. So the kind of research that is typically sponsored by NSF among all the agencies is exactly the kind of research that creates these new industries, creates these new businesses, creates new jobs in the long run. It is a long-term investment.

So the long-term well-being of our society, we believe, needs a strong system of pioneering research which is exactly what the National Science Foundation does well.

I believe this budget succeeds greatly in addressing that issue through the budget proposal which will increase NSF's budget by 8 percent to roughly $2.2 billion in the research. Also, the budget provides sustained investments in what the Commission described as NSF's cascading influence in education.

The budget of NSF's directorate for education and human resources will increase by 14 percent to nearly $560 million and this increase will enable such programs as the State-wide systemic initiatives and the urban systemic initiatives to expand their scope of activities and reach more schools, teachers, and students.

Finally, the budget speaks to the Commission's report through activity that has come under the general heading of partnerships. The related themes of encouraging government, industry, universities, and promoting the dissemination of knowledge were woven throughout that commission's report and both of them are central features of this budget request.

I want to add a personal note to this based on my many years in industry. I spent 37 years in industry and several years in academia. Academic-industrial partnerships, I believe, are especially important right now when many department R&D budgets are under stress and shifting to longer term work.

I believe that NSF can help catalyze more of this partnering and offset this. One of the most noteworthy aspects of what NSF is doing in this regard is seeking to encourage partnerships on a small-scale, one-to-one basis. These activities include traineeships, personnel exchanges, and special research programs that provide incentives for individual academic researchers to seek collaborators in industry, as is done in the program on environmental benign synthesis and processing.

As I noted, Mr. Chairman, this budget is an important investment in the Nation's future. Few areas of public spending can demonstrate the positive, sustained return that has in fact been demonstrated for decades by investments in research and education in science and engineering.

So I want to thank you again for this opportunity to testify on behalf of the National Science Board. I will be happy to answer any questions you may have.

Mr. STOKES. Thank you, Dr. Schmitt.

[The information follows:]

U.S. National Science Foundation
Budget Request to the Congress
Fiscal Year 1994

Dr. Roland W. Schmitt
President
Rensselaer Polytechnic Institute
and
Member
National Science Board

U.S. House of Representatives
Committee on Appropriations
Subcommittee on Veterans Affairs, HUD
and Independent Agencies

March 26, 1993

Mr. Chairman, Representative Lewis, members of the subcommittee, it is a great pleasure for me to appear today on behalf of the National Science Board regarding the National Science Foundation's budget request for fiscal year 1994.

From the perspective of the Board, this proposed budget provides an excellent opportunity to invest in the nation's research and education enterprise and enhance our overall capabilities in science and technology. It also has the very positive aspect of building on the momentum generated by the work of the Commission on the Future of NSF and by the Foundation's own internal planning process.

If I could, I would like to use the bulk of my time today to highlight three ways that this budget speaks directly to the recommendations presented the commission's report, _A Foundation_ for the 21st Century.

First, a very prominent recommendation in the commission's report was that NSF strike a systematic balance between its fundamental, curiosity-driven research activities and research in strategic areas of national priority. I believe that this budget succeeds greatly in this regard, as NSF's overall research budget will increase by over 8 percent to roughly $2.2 billion. The agency will thus be able to boost research activities of all kinds across the entire research continuum.

Second, this budget will provide sustained investments in what the commission described as NSF's "cascading influence" in education. For starters, the increased research budget will enable more students, both at the graduate and undergraduate level, to gain valuable training by participating in research. And, the budget NSF's Directorate for Education and Human Resources will increase by over 14 percent to nearly $560 million. This increase will enable such programs as the Statewide Systemic Initiatives and Urban Systemic Initiatives to expand their scope of activities and reach more schools, teachers, and students.

The third way that this budget speaks to the commission's report is through activities that come under the general heading of "partnerships." The related themes of encouraging government-industry-university ties and promoting the dissemination of knowledge were woven throughout the commission's report -- and both are central features of this budget request.

One of the most noteworthy aspects of what NSF is doing in this regard is perhaps the least visible. I am speaking of the many ways the Foundation is seeking to encourage partnerships on a small-scale, one-to-one basis. These activities include traineeships, personnel exchanges, and special research programs that provide incentives for individual academic researchers to seek collaborators in industry, as is done in the program in environmentally benign synthesis and processing.

As a final note, Mr. Chairman, I would just like to add that this budget is best thought of as a very wise and worthwhile investment in the nation's future. Few areas of public spending can demonstrate the positive, sustained return that has been demonstrated for decades by investments in research and education in science and engineering.

Thank you again for this opportunity to testify on behalf of the National Science Board. I will be happy to answer any questions you might have.

Opening Statement of Dr. Massey

Mr. Stokes. Dr. Massey.

Dr. Massey. Thank you, Mr. Chairman. I believe that the NSF's proposed budget for 1994 presents an excellent opportunity to enhance the overall quality of the Nation's science and engineering enterprise. The overall increase for the Foundation, as you pointed out, would be just over 8 percent above our current level if we assume enactment of the stimulus package currently before the Congress.

Given today's tight fiscal and budgetary environment, it is clear that this budget speaks directly to President Clinton's desire to give priority to those programs that invest in the Nation's long-term economic growth and social progress.

The proposed budget is built around three general strategies for investment. And these strategies were developed from our internal strategic planning process which has been under way for about a year now, as well as the work of the National Science Board Commission on the Future of the Foundation.

The first strategy is enhancing the Nation's fundamental science and engineering capability. The second is investing in people. And the third is addressing strategic research initiatives. These strategies both describe what we do at NSF as well as provide guidance on how the agency should structure its investment in the Nation's scientific and technology enterprises. They are by no means exclusive, however. They are highly complementary and overlapping and each spans a broad range of programs and budgetary categories.

ENHANCING SCIENCE AND ENGINEERING CAPABILITIES

The first strategy enhancing the Nation's overall capabilities in science and engineering, is an overarching priority for the entire Foundation. It is addressed directly in our statutory legislation as expressed in the NSF Act of 1950, where it says we are required to strengthen the Nation's overall potential in science and engineering.

The broad base of fundamental research activities supported by NSF are a valuable asset for all of society. As Dr. Schmitt pointed out, these activities are very often the source of the most valuable and unexpected advances and insights. History is replete with examples of what appeared to be obscure and irrelevant research that has given rise to new technologies and new industrial processes, and in fact, to entirely new perspectives on old problems.

Evidence for this can be found in practically all areas, especially in the emerging growth areas of our economy such as biotechnology, robotics, advanced computering, and communications and the like. Yesterday's laboratory experiments and theoretical insights are creating today's high wage jobs.

In this proposed budget, Mr. Chairman, the Research and Related Activities appropriation increases by roughly 8 percent to $2.2 billion. An additional $55 million was made available for the Academic Research and Facilities Program which supports investments in large-scale instruments and the repair and renovation and construction of facilities at academic institutions.

INVESTING IN PEOPLE

The second strategy for investment embodied in this budget is "Investing in People." It would be difficult to find any phrase that encompasses more of what the Foundation does and what the Foundation stands for than the phrase "Investing in People."

Nearly every dollar that the Foundation spends is in some way an investment in the education and advanced training of members of our society. Research grants provide support for senior scientists and engineers, post-doctoral researchers, technicians, graduate students and also undergraduate and high school students.

In addition, our focused programs in education and human resources provide direct support to teachers and students at all grade and achievement levels in all regions of the country. In short, the Foundation's investment in people permeates activities in every directorate.

In this budget, funding for NSF's Directorate for Education and Human Resources would increase by slightly over 14 percent to nearly $560 million. Examples of our priority areas include pre-college education where the fiscal year 1994 budget will support Statewide Systemic Initiative awards in up to 25 States, but would also allow us to expand the Urban Systemic Initiative program to an expected eight major cities.

A new program, Model Institutions of Excellence, will provide support to predominantly minority institutions for model programs to improve the recruitment, the academic environment, and the retention of undergraduates in science, mathematics, and engineering.

I also want to point out that NSF's efforts in education are carried out in conjunction with other Federal agencies through the government-wide initiative in mathematics and science education coordinated by the Federal Coordinating Council for Science, Engineering and Technology, FCCSET.

In fiscal year 1994, NSF is expected to contribute about one-fourth, slightly over one-fourth of the total Federal funding for this national math and science education initiative.

ADDRESSING STRATEGIC RESEARCH PRIORITIES

Our third investment theme is called addressing strategic research priorities. It is very important that strategic research and critical areas of national priority have become an integral and featured part of the NSF portfolio. The progress of science has always been tied to the application of new knowledge to the pressing concerns of society. Indeed, as Dr. Schmitt pointed out, the Commission on the Future of NSF in its report of last December affirmed that the Foundation should provide "a balanced allocation of resources in strategic research areas in response to national needs."

Under the proposed budget for 1994, the NSF will fund special research initiatives in five strategic areas: high performance computing and communications, manufacturing, materials, global change, and biotechnology.

In these initiatives, our primary focus is on the fundamental research needed to further progress in these areas. In addition, just as with the math and science education initiative, all of these are undertaken in close cooperation with other major Federal agencies.

Furthermore, these five initiatives devote within themselves significant resources to education and training through such activities as curriculum development, outreach and specialized research experiences.

In every instance, the people participating in research receive valuable training that helps prepare them for careers in all sectors of society.

Let me conclude with an observation. The strategies we are pursuing at the Foundation aim to continue America's tradition of excellence in science and engineering while addressing the complex challenges we face as a Nation. We hope to bring about a strengthened academic science and engineering enterprise, a new paradigm in education and work force training, and new partnerships between academia, industry, and government that yield more rapid creation and deployment of new knowledge and new technologies.

SALARIES AND EXPENSES

I would like to close my testimony by taking note of the outstanding work done by the staff at NSF. In this regard, I would impress upon the subcommittee the importance of our request in the category of Salaries and Expenses.

This request would not increase our staffing levels, although a strong case could be made for additional personnel. Rather, it provides us with resources such as computers, increased cost of rent due to our relocation, administrative contractual services, supplies and travel funds needed to keep up and maintain the NSF's work load; a work load, I should note, that has doubled in the past decade while the staffing level has remained approximately the same.

In line with my earlier statements about the importance of human resources, especially support for human resources to conduct the business of the NSF are also crucial for its continued success.

Mr. Chairman, and other members of the committee, I thank you for this opportunity to appear today. As you know, on April 4th, I will be leaving the NSF to become provost and senior vice president of the University of California system. My experience with this subcommittee has been uniformly positive during my tenure and I appreciate the attention and courtesy and concern that members of this committee have exhibited, not only for the Foundation, but for the Nation's welfare.

We will be happy to respond to any questions you or members of the committee might have.

[The information follows:]

U.S. National Science Foundation
Budget Request to the Congress
Fiscal Year 1994

Dr. Walter E. Massey
Director
National Science Foundation

U.S. House of Representatives
Committee on Appropriations
Subcommittee on Veterans Affairs, HUD
and Independent Agencies

March 26, 1993

Mr. Chairman, Rep. Lewis, members of the subcommittee, I am very pleased to be here today to discuss the National Science Foundation's proposed budget for fiscal year 1994. I would like to present a brief overview of the strategies and priorities embodied in this budget, which will be followed by a more detailed description of the budget.

Taken as a whole, I believe that this is an excellent, well-balanced budget proposal that will greatly enhance the overall quality of the nation's science and engineering enterprise. The overall increase for the Foundation would be just over eight percent above our current level (which, by the way, assumes enactment of the stimulus package currently before the Congress). Given today's tight fiscal and budgetary environment, it is clear that this budget speaks directly to President Clinton's desire to give priority to those programs that invest in that nation's long-term economic growth and social progress.

From an investment perspective, there is strong evidence that the types of activities NSF supports make an immense contribution to national well-being. Not only does the continued advance of knowledge lead to new technologies and new sources of jobs, but the education and training aspect of NSF's mission is also a key to future prosperity. Many studies conducted over the years attest to this point. In fact, the Congressional Budget Office, in a recent report on various public investment programs, concluded that "[e]conomic measures suggest generally high rates of return for basic research and academic research in science and engineering...."

All indications are that the importance of science and technology in determining national well-being will only increase in the years ahead. Many areas vital to the nation's future -- from nurturing new industries with high-skill, high-wage jobs, to developing advanced, environmentally-compatible manufacturing techniques, to creating faster, more efficient modes of transportation and information exchange -- require continued progress in fundamental research across a range of disciplines and the adoption of innovative, forward-looking approaches to education and training.

At NSF, we recognize that these emerging challenges and increasing expectations place new demands on us as an agency. Because of this, we are seeking to focus our efforts around new strategies that build on our historical success and at the same time move us toward a new working relationship in science and technology between government, academia, and the private sector.

In the development of this budget, we have given priority to three general strategies for investment.

- First is enhancing the nation's fundamental science and engineering capability.
- The second is investing in people.
- And the third is addressing strategic research priorities.

The work of the Commission on the Future of NSF and our internal planning efforts are strongly reflected in this overall budget proposal and in these three strategies.

These strategies both describe what we do at NSF as well as provide guidance on how the agency should structure its investment in the nation's scientific and technological enterprise. Each one is by no means mutually exclusive of the others: they are highly complementary and overlapping, and each spans a broad range of programs and budgetary categories.

The first strategy, enhancing the nation's overall capabilities in science and engineering, is in many respects an overarching priority for the entire Foundation. It is directly related to our statutory responsibility, as expressed in the NSF Act of 1950, to strengthen the nation's overall potential in science and engineering.

The broad base of fundamental research activities supported by NSF is a valuable asset for all of society. These activities are very often the source the most valuable and unexpected advances and insights. History is replete with examples of how what appeared to be obscure and irrelevant research has given rise to new technologies, industrial processes, and entirely new perspectives on old problems. Evidence of this can be found in practically all of the emerging growth areas of our economy, such as biotechnology, robotics, and advanced computing and communications technologies. Yesterday's laboratory experiments are creating today's high wage jobs.

In this proposed budget, the Research and Related activities appropriation increases by roughly 8 percent to $2.2 billion. An additional $55 million is made available for the Academic Research and Facilities program, which supports investments in large-scale instruments and the repair, renovation, and construction of facilities at academic institutions.

In making these investments to enhance the nation's overall science and engineering capabilities, NSF has structured its programs in ways that provide flexibility to researchers and accommodate the emerging trends in how research is conducted. Our modes of support range from small, short-term grants for exploratory work to traditional individual investigator awards to grants for centers that involve researchers from government, academia, and industry. Additionally, the large-scale research facilities and information processing capabilities supported by NSF -- such as observatories, supercomputer centers, and advanced communications networks like the NSFNET -- facilitate cooperation among researchers and build strong links between scientific research and technology development.

The second strategy for investment embodied in this budget, "Investing in People" is also an overarching description of Foundation activities. In fact, it would be difficult to find any phrase that encompasses more of what NSF is and does than "Investing in People."

Nearly every dollar spent by the Foundation is in some way an investment in education and advanced training of an individual member of society. Research grants provide support for scientists and engineers, post doctoral researchers, technicians, graduate students, and, in certain instances, undergraduate and high school students. In addition, NSF's focused education and human resource programs provide direct support to teachers and students at all grade and achievement levels and in all regions of the country.

In terms of numbers, it is estimated that NSF's programs will reach upwards of 110,000 people, ranging from senior scientists working at major universities to teachers participating in workshops to precollege students attending science summer camps.

Under this budget, funding for NSF's Directorate for Education and Human Resources would increase by over 14 percent to nearly $560 million. Some of the activities supported by this funding include:

- Precollege education, where the FY 1994 budget will support the Statewide Systemic Initiatives in up to 25 states and would allow NSF to expand its Urban Systemic Initiatives program into an expected 8 major cities.

- Reform of undergraduate and graduate education will be accomplished through the establishment of projects to improve teaching in specific disciplines, up to two new engineering education coalitions, and the graduate traineeship program that encourages industrial participation.

- A new program, Model Institutions of Excellence, will provide support to predominantly minority institutions for model programs to improve the recruitment, academic environment, and retention of undergraduates in science, mathematics, and engineering.

NSF's efforts in education are carried out in conjunction with other Federal agencies through the government-wide initiative in mathematics and science education coordinated by the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). In FY 1994, NSF is expected to contribute 26 percent of the total Federal funding for this national initiative.

I want to turn now to our third investment theme, addressing strategic research priorities. It is very appropriate that strategic research on critical areas of national priority has become an integral part of the NSF portfolio. The progress of science has always been closely tied to the application of new knowledge to the pressing concerns of society. Indeed, the Commission on the Future of the NSF, in its report of last December, affirmed that NSF should provide "a balanced allocation of resources in strategic research areas in response to national needs."

Under the proposed budget for FY 1994, NSF will provide significant support for strategic NSF and interagency initiatives in high performance computing and communications, manufacturing, materials, global change, and biotechnology, as well as the previously mentioned initiative in math and science education. In these initiatives, our primary focus is on the fundamental research needed to further progress in these areas. In addition, these initiatives are being undertaken in close cooperation with other Federal agencies.

All of these initiatives are designed to increase the potential for early application of newly discovered knowledge by promoting cooperation between universities, industries, and government. For example, the High Performance Computing and Communications Initiative -- a centerpiece of the President's technology strategy -- would help to create more efficient access to information by all sectors of the economy. In Global Change, NSF supports fundamental research that examines not only the scientific basis of changes in the earth system but also their potential human impacts and policy implications.

Furthermore, all five initiatives devote significant resources to education and training, through such activities as curriculum development, outreach, and specialized research experiences. In every instance, the people participating in research receive valuable training that helps prepare them for careers in all sectors of society.

Let me conclude this portion of my testimony with an observation. The strategies we are pursuing at NSF aim to continue America's tradition of excellence in science and engineering while addressing the complex challenges we face as a nation. We hope to bring about a strengthened academic science and engineering enterprise, a new paradigm in education and workforce training, and new partnerships between academic, industry, and government that yield more rapid creation and deployment of new knowledge and new technologies.

Above all else, the greatest measure of NSF's success -- and of investments in science and engineering in general -- is the continued vitality of America's creative, entrepreneurial spirit. Words written by Vannevar Bush almost five decades ago hold true today: "The pioneer spirit is still vigorous within this nation. Science offers a largely unexplored hinterland for the pioneer who has the tools for [the] task. The rewards of such exploration for the nation and for the individual are great."

Mr. Chairman, thank you for this opportunity to appear today. A detailed discussion of the FY 1994 budget proposal follows.

ACTIVITY SUMMARIES

RESEARCH AND RELATED ACTIVITIES

The FY 1994 Request includes $2,204.80 million for Research and Related Activities (R&RA), an increase of 7.2 percent over the FY 1993 Revised Current Plan. In FY 1994, approximately 65 percent of R&RA will support fundamental and strategic research by individuals and groups in traditional fields as well as in cross-disciplinary fields of national importance. Also included in R&RA is a $58 million increase in support for unique national facilities such as telescopes, research ships, and supercomputers, as well as an increase of $13 million for support for instrumentation and equipment, all of which enhance the research capabilities of the nation's scientists and engineers.

An increase of approximately $40 million, or more than 15 percent, will support activities associated with the FCCSET High Performance Computing and Communications initiative. Also included in the FY 1994 Request are increases for other strategic research initiatives, including Foundation efforts for research on the environment, civil infrastructure and intelligent systems, as well as the Presidential initiatives coordinated through the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). These strategic initiatives are supported within NSF and also by other Federal agencies.

Through its support for programs such as Engineering Research Centers, Science and Technology Centers, and Industry/University Cooperative Research Centers, the Foundation encourages the growth of partnerships among academia, industry and government. NSF also supports a number of innovative programs to support science and engineering training at the undergraduate, graduate and post-doctoral levels.

A summary of plans for each Activity within R&RA follows.

The **Biological Sciences (BIO)** Activity increases by $20.46 million, or 7 percent, over the FY 1993 Revised Current Plan to a total of $311.92 million. The request emphasizes NSF's support for several Federal initiatives. BIO support for FCCSET initiatives and specific research areas includes:

- $6.10 million increase in the Biotechnology initiative to total $119.30 million;
- $6.50 million increase for the environmental research initiative to a total of $70.10 million, including a network of Long Term Ecological Research Sites (LTERS);
- $3.50 million increase to a total of $12.50 million for the High Performance Computing and Communications (HPCC) initiative;

- $1.50 million increase to a total of $10.35 million for Global Change; and
- $1.50 million increase for plant science initiative, including the enhancement of the Arabidopsis genome project.

The **Computer and Information Science and Engineering (CISE)** Activity increases by $33.10 million, or 12.6 percent, over the FY 1993 Revised Current Plan to a total of $296.01 million. CISE will enhance support in the High Performance Computing and Communications and Advanced Manufacturing initiatives, providing support for new generations of enabling technology for high performance computer systems and applications. Also, average award size will be increased to fully enable and expedite research projects.

- $25.24 million increase for HPCC, to a total of $253.87 million;
- $7.25 million increase to a total of $38.65 million for Manufacturing, to increase research on high dependability computer controlled systems; and
- $610,000 increase to a total of $20.11 million for the Advanced Materials and Processing Program (AMPP), for research on modeling and simulation of electronics and optical materials and devices in optoelectronic computing.

The **Engineering (ENG)** Activity increases by $26.22 million, or 8.8 percent, over the FY 1993 Revised Current Plan to a total of $ 343.05 million. The ENG request provides for participation in several broad interagency and NSF-wide FCCSET initiatives in critical technology areas, with emphasis on the support of individual investigators and graduate students.

Highlights of funding increases and specific research areas include:

- $7.50 million increase to a total of $80.90 million, to support the Manufacturing initiative;
- $3.90 million increase to a total of $76.20 million for the AMPP initiative;
- $3.21 million increase to a total of $6.31 million to support the HPCC initiative;
- An increase of $2.63 million to a total of $33.12 million to meet the mandated level for the Small Business Innovation Research (SBIR) Program; and
- $2.50 million increment to a total of $52.50 million for the Engineering Research Centers, to increase the number of centers from 18 to 20. Some of the first class of centers may not be renewed. However, any funds not used for center renewal will be used to fund new centers.

The **Geosciences (GEO)** Activity increases by $27.49 million, or 6.5 percent, over the

FY 1993 Revised Current Plan to a total of $448.50 million. GEO's participation in several broad interagency initiatives includes the following:

- $4.58 million increase in U.S. Global Change Research Program activities to total $124.50 million;
- $2.07 million increase for the HPCC initiative; and
- $100,000 for the AMPP initiative.

Major facilities and instrumentation will increase by $14.72 million to provide support in such areas as NCAR operating and management costs; Global Change; and participation in HPCC Grand Challenge activities. Funds will provide for the conversion of a military C-130 aircraft into a research aircraft; acquisition and deployment of digital seismographs and begin the procurement process of an Arctic research vessel.

The **Mathematical and Physical Sciences (MPS)** Activity increases by $57.96 million, or 8.8 percent, over the FY 1993 Revised Current Plan to a total of $718.39 million. The MPS request provides for enhanced participation in several FCCSET initiatives and a commitment to individual investigators to increase average award size and duration. Funding highlights include:

- $4.54 million increase for the AMPP initiative to a total of $206.44 million, for research focused on synthesis and processing; theory, modeling and simulation; and materials characterization;
- $5.80 million increase for HPCC to a total of $14.68 million;
- $8.20 million increase for the Mathematics and Science Education initiative to a total of $30.85 million;
- $5.74 million increase for environmental research to a total of $14.54 million, with an emphasis on environmental chemistry; and
- $24.00 million increment to a total of $72.00 million for continued construction of the NHMFL, GEMINI, and LIGO.

The **Social, Behavioral and Economic Sciences (SBE)** Activity will increase by $7.96 million, or 8.0 percent, over the FY 1993 Revised Current Plan to a total of $106.91 million. This provides increased support for the FCCSET initiatives and for increased award size across all programs. Funding highlights include:

- $1.10 million increase for the Manufacturing, HPCC, and the Math and Science Education initiatives;

- $1.46 million for an Intelligent Systems initiative, for programs to strengthen the teaching of cognitive skills in mathematics and science; and
- $3.00 million increase to a total of $18.92 million for International programs to support international cooperative research experiences for scientists and engineers.

EDUCATION AND HUMAN RESOURCES

The FY 1994 Request for Education and Human Resources totals $556.10 million, an increase of 14.1 percent over the FY 1993 Revised Current Plan of $487.50 million. Highlights include:

- an increase of $17.30 million, or 20.2 percent, for Systemic Reform activities including a major expansion of the Urban Systemic Initiatives Program begun in FY 1993.
- an increase of $17.00 million, or 34.8 percent, for expansion of targeted efforts to expand the participation of women, minorities and persons with disabilities in science and engineering.
- a 21.2 percent increase, or $13.10 million, for undergraduate education, including expanded support for course, curriculum and laboratory development; initiation of efforts in technical education; and increased support for K-12 teacher preparation activities.
- a $4.70 million increment for activities in high performance computing and communications directed to the establishment and enhancement of education networks.

U.S. POLAR RESEARCH PROGRAMS

The former "U.S. Antarctic Program" appropriation has been retitled "U.S. Polar Research Programs," due to its expanded role in funding polar research. The FY 1994 Request for U.S. Polar Research Programs totals $163.10 million, an increase of 3.2 percent over the FY 1993 Revised Current Plan. This appropriation now consolidates funding for arctic research, which was formerly funded from the Geosciences Activity within the Research and Related Activities appropriation, and antarctic research and operations and science support. The request includes increases for the ice operations of R/V NATHANIEL B. PALMER, improved field party support, South Pole Station and communications facilities.

U.S. ANTARCTIC LOGISTICS ACTIVITIES

The FY 1994 Request for U.S. Antarctic Logistics totals $65.10 million, an increase of $1.74 million over the FY 1993 Revised Current Plan. Because of their extent and remote location, U.S. activities in Antarctica require major logistic support. Of the funds provided under this activity, $59.10 million supports logistics provided by the Department of Defense and $6.00 million are for the final year of the Safety, Environment and Health (SEH) initiative. The Activity contributes to an active and influential U.S. presence in Antarctica as well as addresses environmental problems pre-dating NSF's management of U.S. antarctic logistics and operations.

ACADEMIC RESEARCH FACILITIES AND INSTRUMENTATION

The Request for Academic Research Facilities and Instrumentation (ARFI) for FY 1994 is $55.0 million, a $300,000 increase, or 0.5 percent, over the FY 1993 Revised Current Plan. ARFI will continue to support the development and acquisition of major research instrumentation and the modernization of research facilities. FY 1994 funds will be equally divided between facilities and instrumentation needs.

CRITICAL TECHNOLOGIES INSTITUTE

The Critical Technologies Institute, a federally-funded research and development center, will provide analytical support for technology assessment to the Executive Branch. NSF serves as sponsor for the Institute as mandated by the Department of Defense authorization Act for FY 1992. The FY 1994 Request for the Critical Technologies Institute is $1.0 million, the same level as in FY 1993.

SALARIES AND EXPENSES

The FY 1994 Request for Salaries and Expenses (S&E) is $125.80 million, an increase of $10.10 million, or 8.7 percent, over the FY 1993 Revised Current Plan of $115.70 million. Salaries and Expenses provides funds for staff salaries and other operating expenses necessary to manage and administer the Foundation's program responsibilities, but excludes funds for the Office of Inspector General, which are requested separately. In addition, S&E includes funds for general administrative costs, including information systems and FY 1994 rent on the new NSF headquarters building.

The Request includes funds for 1,203 full-time equivalent staff years who manage and support the programmatic and administrative activity of the Foundation. The Request reflects a reduction in FTEs from the FY 1993 Authorized level, consistent with Administration policies on reducing the size and cost of the federal government.

NSF HEADQUARTERS RELOCATION

The Request for the new NSF Relocation appropriation totals $5.20 million in FY 1994. This appropriation will provide funds for the first of five reimbursements to the General Services Administration, which provided the initial funding for the NSF relocation in FY 1992 and FY 1993 and the FY 1993 rental payments on the new building.

OFFICE OF INSPECTOR GENERAL

The Office of Inspector General (OIG) was established by the 1988 amendments to the Inspector General Act to promote economy, efficiency, and effectiveness in administering Foundation program; to prevent and detect fraud, waste, abuse, and mismanagement; and to prevent, detect, and handle cases of misconduct in science. The FY 1994 Request includes $4.10 million for OIG, an 11.1 percent increase over the FY 1993 Revised Current Plan.

1993 SUPPLEMENTAL

Mr. STOKES. Thank you very much, Dr. Massey, for that presentation. We will open up with some general questions. It is the intention of the chair to observe the 10-minute rule. This is an important agency. We are going to try to conclude with them today so the Chair will try to observe the 10-minute rule as closely as we can.

Dr. Massey, this justification and the accompanying details by the NSF directorate, programs, elements, and subelements are assuming the enactment of the 1993 $206 million economic stimulus supplemental.

If for some reason this bill is held up in the Senate and ultimately the supplemental package is not enacted, would the allocation by activity you proposed for fiscal year 1994 remain the same as we have before us?

Dr. MASSEY. Approximately, Mr. Chairman. We would want to discuss with the committee some adjustments because we have based this request on the assumption that we would have the supplemental. But the priorities would remain approximately the same because this request, as I said, grows out of almost a year-long strategic planning effort as well as the work on the Commission on the Future of the Foundation.

Mr. STOKES. Because we held NSF in the original 1993 appropriation to roughly the 1992 level, the Foundation was forced to make a number of priority judgments on how to accommodate a reduction of roughly $240 million. You proceeded to do that in the 1993 operating plan and we approved that plan.

The question is: Did you consciously give a higher priority to the five initiatives detailed in the budget overview and then also add substantial resources for the same activities in the stimulus bill and in fiscal year 1994?

Dr. MASSEY. In the supplemental, we did make a conscious effort to bring our initiatives up to as close as we could to our original 1993 request, but that only took about half of the stimulus package. The rest of it went into bringing the broad base support for what we call investigator-initiated areas that are outside of the initiatives up close to that request.

HIGH PERFORMANCE COMPUTING

Mr. STOKES. Let's take high performance computing, for example, and run through the numbers beginning with fiscal year 1992, followed by the current plan for 1993, and then the supplemental increment, and then the 1994 increment.

Dr. MASSEY. For the high performance computing, the 1993—the 1992 actual, the initiative.

Mr. STOKES. Start with fiscal year 1992.

Dr. MASSEY. Fiscal year 1992 was $200 million, approximately. We requested $261 million in the 1993 request. And in 1994, the request would be $305 million.

Mr. STOKES. We want the current plan, Dr. Massey, for 1993.

Dr. MASSEY. The FY 1993 Revised Current Plan would be $261 million.

Mr. STOKES. We want the original current plan for 1993 and then the supplemental increment to follow that.

Dr. MASSEY. The 1993 request, $261 million. The current plan before the subcommittee is $225 million. If we get the supplement, that would bring it up to $261 million. That was the right number.

Mr. STOKES. If you could give us the 1994.

Dr. MASSEY. The FY 1994 request is $304 million. Those are the numbers. I am sorry.

U.S. NOBEL PRIZE WINNERS

Mr. STOKES. Last year, Dr. James L. Powell, President and CEO of the Franklin Institute, appeared before the subcommittee as the representative of the National Science Board. He made a number of interesting points, including that since 1991, the United States has won over 400 Nobel Prizes in chemistry, physics, and physiology/medicine, while Japan has won only four.

He also indicated that the United States was one of the very few countries that allow 16-year-old kids to make the decision to give up any additional math and science course work. The point he was making was that it was important to get a little more rigid and require more students to complete higher levels of math and science requirements before we sort of let them off the hook.

I guess what we are curious about is, since this country has historically allowed children to exercise that option at such an early age, how did we manage to win 400 Nobel Prizes?

And we are wondering if the answer is that most U.S. Nobel Prizes were won by foreign born or foreign educated scientists.

Dr. MASSEY. Well, that is certainly part of the answer. If one goes back and traces the history of major breakthroughs in leadership in our science and engineering, we find a very large number of scientists in their 40s and 50s and 60s are foreign born. And even some of the younger scientists are foreign born, even if they are educated in the United States.

The other part of the answer is the United States has always been very good in producing a highly select number of people who can understand and participate in science at a very high level. I think our problem now is that the Foundation's programs are more and more addressed to bringing the broad base of our society into these fields, if not as professionals, at least as the citizens who understand and appreciate and can participate in science and technological activities and especially in policy issues that grow out of them.

NSF FULL TIME EQUIVALENTS

Mr. STOKES. Another point that Dr. Powell made was that the ability of the NSF to maintain itself as the premier science agency in the world was threatened not by insufficient funding, but rather by a lack of money available for additional staff that he felt was so essential to handle an ever-growing proposal and grant backlog.

After he made that remark, we asked what your 1993 request was of the OMB for staff, and you indicated it was 1,300 FTE.

It is interesting that your 1994 request does not begin to meet the problem he identified but seems to be heading in the other direction in that it is a decrease from 1993 to 1,204 FTE.

Dr. Powell was getting at the point that without additional staff the Foundation could not efficiently manage and monitor the money available at the 1992 level, let alone a $440 million increase. So you are asking us to fund an 18 percent increase while you are also suggesting a decrease in staff.

The question of you is, If Dr. Powell was right last year, then we should not fund most of the increase. What would your reaction be to that?

Dr. MASSEY. I would like to put another interpretation on that, Mr. Chairman.

Mr. STOKES. We assumed that you would.

Dr. MASSEY. You are correct. Last year we did request almost a hundred more FTEs than we are requesting this year. Two things I think have taken place: One, it becomes quite apparent that order of request is simply not going to be possible in the budgetary environment that we face. So like all other organizations, we had to just take very, very serious looks at how we do business.

Part of our strategic planning process that we have gone through over the last year has been looking at how we manage our functions. We are putting more reliance on the use of computers, the use of electronic equipment, even trying to get the university community to interact more with us electronically and become less people intensive.

So this is a very tight budget for us, the request this year in terms of FTE, but I think we feel if we get this request and if we can implement the changes in the way we carry out our business, then in a very tight situation, we will certainly be able to manage responsibly this increase we are requesting.

Mr. STOKES. Let me just ask you this. If we go back to his point—and that is without the additional staff that this just could not be done—are you saying that he was wrong on that?

Dr. MASSEY. If we had kept doing business as we were doing it, I think he probably would have been right. The way we reviewed proposals, the way we used panels, the way we used our staff in handling the proposals that come in, we are changing all that. We simply have to. It is like IBM. Every other company is changing the way it does business.

Mr. STOKES. Thank you.

Mr. Lewis, I recognize you.

Mr. LEWIS. Thank you, Mr. Chairman.

In a moment, I want to follow up on that question, but before getting to that, Dr. Massey, I want to welcome you and your associates. I think it is a very important to our responsibility in the subcommittee dealing with the key element of the scientific community. Give me an idea of where you are going to live after April 4th if you become provost.

Dr. MASSEY. In the Berkeley-Oakland area.

Mr. LEWIS. It is a nice part of the world.

Dr. MASSEY. Thank you. I look forward to it.

COMMUNICATION WITH OTHER AGENCIES

Mr. LEWIS. I may have you visit my grandchildren when you are there.

Discussing the tight budgets and reduction in personnel, I presume that in your responsibility, at least from time to time, there are direct links with the President's national science advisor as well as people in the Department of Education who are dealing with these very important areas, too.

I met with the science advisor the other day, and I was reminded of the conversation as you were giving your testimony. The Chairman's last question reflected on it also.

I am concerned that in the National Science Foundation your leadership may move too far too quickly, especially operating in a subcommittee where the sciences are competing with small operations like the Veterans Administration, and Housing, and et cetera.

If you start out on a plateau that is somewhere below the mark, I am very concerned that we don't overexercise our propensity to cut into programs like yours and like NASA and others just because there is so much people pressure and demand elsewhere. So I am just wondering if you took that into consideration. If not, I would urge you to do so. And I certainly would urge communication with people like the science advisor.

Dr. MASSEY. Thank you. We have. On your question, we are in very close contact with the OSTP and personally, myself, with Dr. Gibbons. We work very closely in a number of areas that you will hear about later with the Department of Education.

BALANCE BETWEEN INDIVIDUAL INVESTIGATORS AND CENTERS

Mr. LEWIS. The December 1992 Ad Hoc report on Research at Universities, which you ended up chairing in the absence of Dr. Kerns, contains the following recommendation: "Federal agencies should balance continued strong support for individual investigators with effective focus on centers and groups and on multi-disciplinary research."

Have you reached such a balance in this budget? Can you give us a breakdown of the amounts within your research accounts and each of the activities that will go to individual investigators versus centers?

Dr. MASSEY. Yes. I can supply you with that by directorate, but I can give you the numbers which are pretty consistent across the Foundation. Roughly 5 percent of our budget goes into activities which we label centers, science and technology centers, engineering research centers, materials research laboratories, and others of that type.

The individual investigators and small groups constitute roughly two-thirds of our research budget across the Foundation. And while it varies a little across the programs, that is roughly the distribution.

In terms of multi-disciplinary research versus disciplinary research, it is a lot more difficult to break that out but that is growing, I should say the trend, not just at the Foundation, but in science and technology itself is more towards activities that cut across disciplines. So that will be growing faster than in the other areas.

[The information follows:]

Balance of NSF Support

The estimated balance of support for research across the National Science Foundation is:

[In percent]

	FY 1993 estimate	FY 1994 estimate
Individual investigators and small groups	63	64
Centers	7	7
Facilities	30	29

The estimated balance of support for research within the Research and Related Activities appropriation is:

[In percent]

	FY 1993 estimate	FY 1994 estimate
Individual investigators and small groups	71	71
Centers	8	8
Facilities	21	21

The estimated balance of research support for each activity within the Research and Related Activities appropriation in FY 1994 is:

[In percent]

	Individuals and groups	Centers	Facilities
Biological sciences	95	5	0
Computer and information science and engineering	53	3	44
Engineering	76	23	1
Geosciences	64	2	34
Mathematical and physial sciences	62	8	29
Social, behavioral and economic sciences	99	1	0

All of these modes of research—Individual Investigators, Groups, Centers and Facilities—support both disciplinary research and multi-disciplinary research.

INTERAGENCY DEFENSE CONVERSION

Mr. Lewis. President Clinton offered a proposal a couple of weeks ago for a major interagency defense conversion program. NSF has a role to play in coordinating the effort, but I don't see any specific new initiatives in the 1994 budget request. What does NSF bring to the conversion process and can we anticipate support for more direct NSF participation such as engineering traineeships or retraining programs sometime in the future?

Dr. Massey. You can definitely. As we go into details in our Engineering Directorate, we could have Dr. Bordogna submit more detail. There are two answers to that.

In the 1993 budget, which is not reflected here, there is a defense conversion appropriation of approximately $500 million. It is being managed by Department of Defense, but actually they have decided to have it be overseen by a multi-agency group called the Defense Conversion Technology Council on which I sit as director of NSF, but has representatives from NASA, DOD, and NIST.

A program description for that has been issued in the last two weeks and by the end of May, there will be an RFP soliciting proposals. NSF is definitely part of that and just in the areas you mentioned: Manufacturing, engineering, and education and the like. We could go into more detail. We can wait until you want to go through the engineering budget and perhaps hear about it then.

INDUSTRIAL PARTNERSHIPS

Mr. Lewis. I have had the opportunity to review portions of the November 1992 report of the Commission on the Future of the National Science Foundation. Its bottom line is that science is turning into technology at a quicker pace than it used to and that is good for everyone.

But what it would seem to mean for you is that the National Science Foundation may need to find better or more direct ways of linking the institutions that generate new knowledge with the people who would use it.

The report specifically endorses the increased use of partnerships between government, industry, and academia as well as allowing the private sector to play a more significant role in evaluating the effectiveness of NSF expenditures.

This year's budget contains requested funding for two new engineering research centers as well as a new ecology center in the biology directorate. To what extent do existing NSF support centers interact with business and industry? Has the private sector ever been involved in evaluating the effectiveness of the Foundation's use of relatively scarce NSF research dollars for annual operations such as the supercomputer business?

I am, frankly, interested in knowing what relationship there is and whether we should attempt to develop that further. I don't know exactly what is appropriate here. I would like to hear your comment.

Dr. Massey. Well, let me tell you the present situation, then tell you about our plans for improving it.

Industrial representatives are very much involved in all aspects of the Foundation, especially in the centers. Each of our Engineering Research Centers, as well as the Science and Technology Centers, have advisory boards and committees that are made up of primarily if not more than 50 percent of representatives from industry. And those boards do evaluate the programs.

In addition, the research programs themselves call for the involvement of the scientists and engineers from industry working alongside engineers and students in the university. We have hundreds of industry people involved, in fact.

On the average, I think 30 or more have been involved with each Engineering Research Center. That works very well, I would say. Where we have been trying to improve our efforts is involving more industrial scientists and engineers in the broad activities of the Foundation—on our review committees that review proposals, on our advisory committees that advise us on long-term planning, and the like. Although we have some representation there, we think we can have more.

We will be working more to develop partnerships. In fact, that is one of the main themes of our strategic thinking for 1994, is to have more partnerships with other agencies. So the answer to the question, we are moving to implement those recommendations made by the Commission.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. STOKES. Mr. Mollohan.

Mr. MOLLOHAN. Mr. Chairman, I would like to follow up a little bit on Mr. Lewis' question, if I might, but I first want to welcome you for the last time in this capacity before the committee and thank you for your wonderful service and wish you well when you go off to California.

Dr. MASSEY. Thank you.

NSF ROLE IN TECHNOLOGY TRANSFER

Mr. MOLLOHAN. The Commission's recommendations you pointed out appear, as Mr. Lewis alluded to emphasize that NSF should get more involved with meeting new National priorities. Certainly the President is pushing very hard for our Nation to be more aggressive in technology and the transfer of technology in order for us to be more competitive in the international marketplace.

I am wondering, as NSF looks at its overall mission and how it allocates its resources, whether NSF views this policy recommendation as a mandate for the agency to get into new areas Do you plan to expand the scope of your investment in research? I mean, to go beyond basic research and into applied activities?

Dr. MASSEY. No, we do not. The Commission emphasized, first of all, that the National Science Foundation's support of fundamental research of a long-range nature is its most important contribution to the Nation's welfare because we are the only agency that has specific designated responsibilities to support the Nation's science and technology base across broad areas.

What they did say is that we could balance that portfolio between ideas that come unsolicited in every area from researchers with participation in initiatives that are agreed upon at a broader national level.

They also encouraged us to contribute more to technology transfer by working through the partnerships with other agencies whose mission is more closely aligned with the front-end, such as NIST, in those areas.

NSF/NIST PARTNERSHIP

Mr. MOLLOHAN. Supporting them in their activities?

Dr. MASSEY. And working jointly, exactly.

Mr. MOLLOHAN. How do you see that working? How do you see your role supporting their more direct transfer activities?

Dr. MASSEY. We will sign an MOU, in fact, next week between NIST and NSF. We will have a copy that spells out something specific. I can give you some examples of kinds of things they have that they call advanced technologies.

Dr. SCHMITT. Manufacturing, there are two programs. One is the Advanced Technology Program and the other is the Manufacturing Technology Extension.

Dr. MASSEY. Those are designed to work really with industry—local, small companies or large ones—to bring them up to date on the latest in technologies. But they bring them up on the latest in technologies that are known, that are already developed.

We have Engineering Research Centers and Science and Technology Centers that are in the business of developing new processes and procedures coming out of the universities in the fundamental sciences.

So how do we get that to industry? Well, some of it can go directly to industries participating in universities. Some can go via connections between NIST centers and our centers.

Dr. SCHMITT. Could I comment on that?

Mr. STOKES. Mr. Schmitt.

Dr. SCHMITT. My university happens to have a manufacturing and technology center and we have some research centers and I just want to emphasize what Walter said. It really does work that way. In this manufacturing technology center, the NIST program reaches out to small and mid-size firms—which, incidentally, I think is an arena of our economy there—there is a lot of leverage to be gotten from the introduction of new technology.

Now, the people working in that center don't generate new technology on their own. They look around them. They look down from this lab at NIST laboratories. They look to the centers on our campus in manufacturing and design and things like that. And so they are in fact kind of a transfer agency that draws on the center's campus—draws from centers outside.

Mr. MOLLOHAN. Are you talking about science and tech centers or engineering centers?

Dr. SCHMITT. I am talking about the manufacturing and technology centers. The NIST center.

Mr. MOLLOHAN. Do you interface with the MTC's right now?

Dr. SCHMITT. That is correct. It is on our campus. It doesn't try to generate new technology on its own. It draws only from the technology around it.

Mr. MOLLOHAN. It is an extension service in one of its function?

Dr. SCHMITT. I don't use the word extension, but that is sometimes used.

Mr. MOLLOHAN. What word do you use?

Dr. SCHMITT. I just say manufacturing and technology center. They go out and they have—unfortunately, I am not well enough acquainted with the agricultural extension to know whether the analogy is good. They really go out in the community and they work on site with these small manufacturing companies, the companies that have 50 or 100 employees, sometimes larger, and really do pump new technology into it.

ENHANCING TECHNOLOGY TRANSFER

Mr. **Mollohan.** Given the President's emphasis on technology transfer as an essential ingredient to making the Nation more competitive, is there any change in NSF's role, in this regard: Enhancing the activity in terms of quantity, if not in terms of scope?

Dr. **Massey.** Yes. I would use the word build on and, as you say, enhance in scope. That may be a way to do it. But the way we are going to approach that is not by abandoning what we do and what we have to do, but trying to build on it.

I guess there are three ways we would do that. One is by participating more vigorously perhaps than we have in these initiatives and starting new initiatives.

Mr. **Mollohan.** Which initiatives?

Dr. **Massey.** The manufacturing initiative, for example.

Mr. **Mollohan.** NSF initiatives?

Dr. **Massey.** They are NSF initiatives now, but they will be FCCSET initiatives. We have been instrumental in initiating these. One is in manufacturing and another in civil infrastructure programs, to look at new technologies that would be necessary for rebuilding the country.

Mr. **Mollohan.** You would look at that?

Dr. **Massey.** We are starting that, but it is growing into a multiagency activity.

MANUFACTURING INITIATIVE

Mr. **Mollohan.** What directorate at NSF would have responsibility for that?

Dr. **Massey.** The Assistant Director for Engineering, Dr. Bordogna, has the leadership, although the directorates will participate. The other way we are doing it is through trying to bring the people together, the people who generate new ideas, new technologies and knowledge, trying to make it easier for them to interact with people and places that use it.

Mr. **Mollohan.** To create a pipeline?

Dr. **Massey.** Or a connective system, exactly. We want to have and we will have more programs that allow graduate students, perhaps, to spend some time doing research in industry as well as on campus, and to allow industrial scientists to spend time on campus in a program in the Defense Conversion Act called "Manufacturing in the Class"——

Mr. **Bordogna.** "Manufacturing Experts in the Classroom."

Dr. **Massey** [continuing]. "Manufacturing Experts in the Classroom" will bring people from industry who are participating and actually involved in manufacturing at the front end into the classrooms where future engineers and technicians are being trained.

Mr. **Mollohan.** Is that what you just described on the last page of your written testimony, and I quote, "We hope to bring about a strengthened academic science and engineering enterprise, a new paradigm in education and work force training, and new partnerships between academic, industry, and government that yield more rapid creation and deployment of new knowledge and new technologies"? Is that part of what you are saying?

Dr. **Massey.** Yes, exactly.

Mr. MOLLOHAN. Mr. Chairman, if I could have another minute.

Mr. STOKES. Sure.

GRANT SIZE

Mr. MOLLOHAN. Also in the National Science Board, they make other recommendations. One is that you should award more money per grant. In the increases that you have requested, where do you think they should go? To increasing your awards per grant or to do more granting? Or both?

Dr. MASSEY. Our priority will be to bring grants up to the level, as we use the term, to really enable the scientists and engineers to do the research. In fact, if the supplement is enacted, practically all of those funds will go to bring existing programs and awards up to the level that we would like to have funded if we had had the money.

Mr. MOLLOHAN. So would you say that a defining characteristic of your grant program has been that each grant have been underfunded in order for NSF to award more grants?

Dr. MASSEY. That would be an accurate description of the situation we have been in for the last few years.

Mr. MOLLOHAN. And you are going to use the supplemental money to get the existing grants up to or approaching full funding?

Dr. MASSEY. We won't be able to bring them up to, quote, full funding. But that would be the goal, to put that money into existing grants and programs to bring them up closer to the level that they should be funded, yes.

Mr. MOLLOHAN. And any increases you receive this year in the regular 1994 appropriations cycle would be used first to bring grants up to what you would consider adequate or full funding?

Dr. MASSEY. The 1994 request would be to, I guess, cover several areas: One, to support renewal grants because the large majority of our grants are continuing.

Mr. MOLLOHAN. Multi-year?

Dr. MASSEY. Right. They are continuing. Some funds will be used to try to bring particular areas up closer to full funding and other funds will be used to fund new opportunities, so the 1994 Request is across the entire spectrum. The 1993 supplement will be mostly enhancing.

Mr. MOLLOHAN. If you are going to enhance the 1993, then the 1994 increases, you are going to keep that, I assume?

Dr. MASSEY. Yes.

Mr. MOLLOHAN. I think I understand.

Mr. STOKES. Mr. Torres.

Mr. TORRES. Mr. Chairman, if I might pass, I just walked in.

Mr. STOKES. Mr. Thornton.

Mr. THORNTON. Mr. Lewis, I yield to you for a moment.

CENTER AND FACILITY SUPPORT

Mr. LEWIS. Thank you. It was a supplement to Mr. Mollohan's question, briefly you used the percentage, 5 percent for centers. Is that a reflection of the current budget or the 1994 proposal?

Dr. MASSEY. Both. It won't change that much at all.

Mr. LEWIS. What percent of this for centers, facilities, and ships.

Dr. **Massey**. Facilities account for roughly 20 percent. And we include in that not only telescopes, ships, and airplanes, but also large research activities such as the National Center for Atmosphere Research, which is a large grant—it is almost $50 million itself. It is not an instrument, but we count it as a facility.

Mr. **Lewis**. Thank you.

Mr. **Thornton**. Mr. Chairman, if I may continue?

Mr. **Stokes**. Yes.

Mr. **Thornton**. Welcome again to the committee. It is a pleasure to see you. I want to congratulate you on the excellent job that you have done as head of the NSF and congratulate you, I think, on moving into the position of provost of the University of California system. It will be a challenging job and I know you will do very well.

Dr. **Massey**. Thank you.

EPSCOR

Mr. **Thornton**. A few years ago, you said a moment ago that related to the charge of the NSF, which is to promote the development of science throughout the country, a few years ago the agency was rather strongly biased toward that particular side of the charge that was reflected in peer review projects and there were those of us on the authorizing committee—I was the Chairman of the Science, Research and Technology Committee—who were concerned about whether that met the entire charge of the agency for the overall health of science and engineering across all disciplines and throughout the nation.

Dr. Richard Atkinson was testifying before my subcommittee and I asked him how many peer reviewed projects had been accomplished in the State of Arkansas. He said, Mr. Chairman, I will have to furnish that information to you on the record later on for your information. And we went ahead with the hearing. Immediately following, Dr. Atkinson came up and called me Ray, he said Ray, I knew the answer, but I didn't want to embarrass Arkansas or you by pointing out that Arkansas got virtually no money on peer review NSF money. And we led to the development of the EPSCoR program, the experimental program to stimulate research.

Recognizing as both of us did that science was not restricted to the West Coast or the East Coast but might be found anywhere in the United States. And the rationale for that was the point that NSF not only does science but has a charge to improve and enhance the scientific foundation throughout the country. Do you agree with that element of the charge? And how is EPSCoR doing?

Dr. **Massey**. I definitely agree. I was on the National Science Board at that time as a matter of fact. EPSCoR, I think, has proven to be a very innovative program. As you know now, we are in 19 States and Puerto Rico. In fact all of the States that are eligible by the criteria that is set forth in terms of the number of grants they receive through the regular competitive process will be competing for new awards this year to enhance their capability.

I visited a number of EPSCoR States, I made a point to do that. I didn't get to Arkansas, I am sorry to say. But Mississippi, North

Dakota, West Virginia and others, and I am impressed by what has been done.

One of the, I think, important aspects of the EPSCoR program has been that it stimulated the science and technology leadership at the local level to do more effective long-range planning and investment.

Mr. THORNTON. And high-quality research. Absolutely. No step down in the quality of the research; is that correct?

Dr. MASSEY. That is the program.

Dr. SCHMITT. If my memory is correct. Some of that pioneering work done at the University of Alabama at Huntsville on superconductivity was EPSCoR work.

Mr. THORNTON. University of Arkansas. I was going to get to the cascading effect that you mentioned. At the University of Arkansas, Arkansas was one of the first EPSCoR States, and at the university during the first year of the program, the scientists won a national award. Then because of the interest in science, we recruited Dr. Allen Herman and Dr. Yiange Chang to the University of Arkansas resulting in a couple of years in an attitude of almost incredulity on the part of the New York Times which wrote about the little laboratory that could, namely the University of Arkansas with what is still the world's highest temperature superconducting material, the thallium material, funded not through EPSCoR or the NSF but the cascading effect.

Dr. Schmitt, and of course Alabama does a lot of pioneering work but the thallium work was——

Dr. SCHMITT. I agree with that but my memory tells me that EPSCoR funded some of that work.

GOVERNMENT ACADEMIA INDUSTRY PARTNERSHIP

Mr. THORNTON. Indeed. EPSCoR funded some of that and the cascading effect led to what remains. The world's highest temperature operating in a liquid nitrogen regime. And the University of Arkansas has patents on that, Mr. Chairman, and is eager to see the dissemination of that technology into the marketplace.

The reason for the questioning, though, sir, is that that was an exercise on the part of the Foundation and the Board in meeting new challenges in vision. And today you are outlining to us a similar new challenge which is to develop partnerships, to recognize that there is nothing wrong with government, academia and industry working together to harness the inventive genius of the American scientist who have won the Nobel prizes to the marketplace so that we can provide better jobs here at home.

Do you consider that a major element of the Foundation's work?

Dr. MASSEY. You said it much more eloquently than I could, but that is exactly the new paradigm we referred to that we are trying to accomplish.

NSF ROLE IN EDUCATION

Mr. THORNTON. In order to do that, I think it is also necessary to address the entire fabric of science education. Sometimes we tend to think that the Nobel laureate moves into existence as if by magic, when in fact my observation of education is that it is not built like a pillar which you stack one boulder on another and reach a zenith, but more like an hourglass where sand is dropped into the glass and as the height of the cone increases, the breadth must also increase.

So you have to have an entire fabric of education that will support the excellence of the Nobel laureate. And I am trying to wheel this around to Dr. Luther Williams——

Dr. MASSEY. I see.

Mr. THORNTON [continuing]. Whose program in addressing the needs for a solid foundation seems to me to be so important. I am pleased to see that you have emphasized that in the budget. Can you give me any of the directions that you plan to take in that program?

Dr. MASSEY. Yes, and we can go into more detail as we look at the EHR budget. But in general the philosophies that you are using exactly characterize our budget, and we will use your words: I think that is a frontispiece for it.

We are trying to link everything that we do together so that it constitutes an integrated whole. We need to support not only the first-rate science at the cutting edge but to make linkages and partnerships between people that do that science and those that have to use it to improve the quality of life in America. And also to build up that base of human resource: people who may not ever enter science at all but are going to have to be part of a citizenry that operates in an increasingly complex world.

The Foundation has that full set of responsibilities. I think we have always addressed them but in a more compartmentalized fashion than we want to now. When I use words such as bringing our educational activities throughout the Foundation, I mean that we don't confine that to just Dr. Luther Williams; everybody will be responsible for looking at their programs in terms of how they meet those goals.

Mr. THORNTON. As we address the question of competitiveness in materials and manufacturing, and the various disciplines that are represented at this table, networking of those people together, it would seem to me is very critically important. And that is what you are trying to do.

Dr. MASSEY. Exactly right and our Commission on the Future of the NSF pointed out this in the area of "technology transfer", that it is not a matter of developing devices and passing them along, that the most effective way of moving information is by people' that people have to interact with each other. That is certainly the goal of the programs that we have.

Mr. THORNTON. I want to congratulate you for the work that you have done. If I have not used up my 10 minutes Mr. Chairman, I yield back the balance of my time.

Mr. STOKES. Thank you very much, Mr. Thornton. Mr. Torres.

SUPPORT FOR INNOVATIVE TEACHING

Mr. TORRES. Thank you, Mr. Chairman. I apologize for being late. I was detained inadvertently but I want to join my colleagues, Dr. Massey, in congratulating you on your new position in California. I am delighted to note that you will be joining the University of California in my home state as the provost. I know it is a loss for the National Science Foundation, but obviously I am pleased that you will continue to use your talents at the University of California.

I was pleased to read in your budget narrative that the NSF believes we need broadened opportunities in science and technology for people of every race, gender and background. And I personally believe that if this country is to move into the 21st century prepared to meet the challenge of that century, all of our citizens have to be provided, especially our children, these types of opportunities.

I have a number of questions that are directed just at how the NSF will achieve these goals. I am particularly interested in your education and human resources effort, and the amount of resources the NSF is devoting to programs aimed at organizations and the institutions that are uniquely suited to reaching traditionally underserved individuals.

My question is: Can you tell me how much NSF funding is devoted to K through 12 schools that have already adopted innovative methods of teaching math and science? For example, how much funding is provided to schools that use classroom-based live interactive distance learning? Are there any existing cooperative arrangements between NSF and school districts to promote the use of educational technologies in schools for math and science?

Dr. Massey. The last one I can answer precisely, yes. And that is a growing area, the use of educational technology. There is a request in the budget for an increase in funds for work both in the Education and Human Resources Directorate and our Computer and Information Sciences and Engineering Directorate to use the high-performance computing and communication initiative for that.

On the first two, I don't know those numbers, we can certainly supply them, but Luther, would you happen to know how much money we spend now in programs that use innovative–I think it would be better if we could get you that for the record, the exact numbers.

[The information follows:]

Innovative Teaching Methods

In FY 1992, approximately $9.5 million was funded for distance learning projects which utilized satellite transmissions, and an additional $6 million for projects that used computer networking. In addition, nearly $3 million was spent on innovative testbeds. Funding for educational technologies in schools totalled approximately $34 million for FY 1992.

SUPPORT FOR TEACHER TRAINING

Mr. Torres. I need to know that information and I would request that from you.

In reviewing the fiscal year 1992 awards, there are large variations in the amounts of funding granted to institutions of higher learning versus local school districts. It appears to me that local school districts receive relatively few awards even though such entities may be better suited to training teachers and serving students who are most at need of math and science education.

At the risk of sounding parochial, can you tell me how much is funded in the Los Angeles area for the training of science and math teachers and public schools?

[The information follows:]

Funding for Teacher Training

Funding in the Los Angeles area for the training of teachers totalled approximately $11 million in FY 1992.

Dr. Massey. No, I really couldn't. I just wouldn't have that level of detail. I am sure that we can break that out.

SUPPORT FOR TWO-YEAR COLLEGES

Mr. Torres. I understand that of the almost $3 billion NSF budget for fiscal year 1992, only $3.5, million or 1 percent, went to grants for two-year colleges, and of this very small amount, half went for instrumentation and laboratory improvements. Given the unique nature of these institutions, and I have many of these institutions in my district, four to be exact, to reach a broad cross-section of those students most in need of math and science education, and the NSF's purported intent is to broaden opportunities for people of every race, gender and background. Can you explain the discrepancy, that low amount?

Dr. Massey. Yes, I can characterize it, if not explain it. I think historically our tradition of funding has been through the peer review process and research areas and very little research takes place at the two-year colleges. It is only within the last six years that we have been putting more and more emphasis, as you know, on, K through 12 education, and now we see more clearly that we have to put emphasis on the whole spectrum, K through graduate school.

So you will notice in the 1994 request that we will be building up our funding to two-year colleges. We are requesting $12.5 million in the 1994 request.

We are looking more and more at ways to use two-year community colleges, however you might label them, as part of our program, but that has not historically been the place where NSF has put emphasis. But in the future, we will be.

LIAISON FOR COMMUNITY COLLEGES

Mr. Torres. I am happy to hear that. Public Law 102–476 established a designated liaison for community colleges within the NSF. Have you designated an individual to comply with this congressional mandate? And if not, do you plan to fill it?

Dr. Massey. We have. Yes, we have.

Mr. Torres. You have someone who carries this out? Mr. Chairman, that concludes my line of questioning and I yield back the balance of my time.

SCIENCE AND ETHICS

Mr. Stokes. Thank you very much. Continuing the general questions, and posing a question to you on science and ethics. Dr. Massey, recently there have been a number of highly publicized cases involving misconduct by very prominent researchers, and of course this is a question now that has been given a great deal of media attention.

And the question to you, is there a serious problem in terms of ethics in science?

Dr. MASSEY. I would not say that it is a serious problem in terms of the number of cases like that. But you might be interested in some of the things that we are doing in looking at this issue, and I think fortunately Dr. Schmitt is here. He chairs the oversight committee of the Board and that is the committee of the Board that has been working with the National Academy of Science and others to in fact get the kind of information that would answer that question, and formulate the kinds of procedures and rules that will allow us to regulate ourselves.

Mr. STOKES. Dr. Schmitt, would you like to comment on that?

Dr. SCHMITT. I would be happy to. I think that the system of dealing with those issues at NSF that is evolving and being put in place is superb. None of the prominent cases that I know of have been with NSF grants, although there have been cases that have had to be dealt with.

But we have had a discussion with the chairman of the Academy committee that looked at misconduct in science. The scope of their study did not extend to the scope of issues that NSF has to deal with, but after discussions about them, I think we are converging on a set of definitions that is compatible with their position by permitting NSF to deal with all the misconduct that extends beyond the scientific misconduct alone.

In addition, the NSF and the Inspector General, we have clearly distinguished between the investigatory aspects of this and the administrative aspects of it. In other words, the Inspector General finds these cases, investigates them, but then it is the Foundation executives, the Director, Assistant Directors who make the decisions about the final sanctions.

And I would just say that I believe that the system at NSF is evolving in the right direction and is going to be a very exemplary method of dealing with the issues that you talked about.

ROLE OF SCIENTISTS

Mr. STOKES. Let me ask you a specific aspect of this particular work. Recently Chauncy Starr, President Emeritus of the Electric Power Research Institute made a comment which I will quote.

"In the early days of scholarly science the field was chosen as a personal career for its intellectual rewards: Today science is an institutionalized industry. However, science is not an entitlement for scientists, demanding society's support. Support of science goals should be deserved by its contributions to national needs and balanced against other social goals."

The question we would ask is has the National Science Foundation's program become more and more an entitlement program for scientists?

Dr. SCHMITT. Do you want me to comment on that?

Dr. MASSEY. Yes.

Dr. SCHMITT. I don't think that is true. I admire Chauncy Starr very much. He happens to be a graduate of my institution. You will pardon the commercial. But let me distinguish between the attitudes of some individual scientists, who are not sophisticated in these things, may have. These are people who are totally interested in their science and their subjects and research and the depth of it and so on and it frustrates them not to get the support in order to do what they want to do.

And sometimes you see statements in the press that stem from that very narrow kind of perspective. Contrast that with the way that the National Science Foundation works however. There is nothing in the system of review of proposals or the way the proposals are awarded that smacks in any way of an entitlement program.

As a matter of fact, a complaint that you will frequently hear and I have heard many times from scientists who have had years of support whose support suddenly vanishes, and I can give you one very fine example of a faculty member at Stanford who I have heard has complained. He clearly did not have an entitlement and he discovered that he did not have an entitlement.

Mr. Stokes. Thank you. Dr. Massey did you want to add anything?

Dr. Massey. I think that is true. If you look at our statistics in terms of the turnover of grants and the portion that we can fund, in terms of the requests that come in, I think it would be difficult to make the case that people who get funded from science agencies, including NIH, consider it an entitlement.

I think in terms of the broader questions of whether the scientific community feels that the nation ought to support science, not individual scientists, I think the scientific community does feel strongly that that should be a high priority, not because it is an entitlement but because the past has shown that this investment pays off.

As I said in my testimony, yesterday's insights and experiments are now today's jobs and new industries. So sometimes the rhetoric that is used by the community may sound as if they think they see themselves as a special group entitled to funds. I don't think that is reflective of the reality.

NEW GRANTS PER YEAR

Mr. Stokes. What would you say are the percentage, of new grants each year?

Dr. Massey. It is about a third. Yes, about a third.

Mr. Stokes. Are we talking about people who have never received a grant?

Dr. Massey. About a third of the awards go to people coming into the system.

Mr. Stokes. All right. We are now going to move into the directorates. I think what we would like to do is any Members that wants to intervene at any point, just feel free to do so, rather than to take the 10 minutes as such.

AWARDS TO K-12 INSTITUTIONS

Mr. Lewis. Mr. Chairman, before you go to the general audience——

Mr. Stokes. Additional questions?

Mr. Lewis. Just a general question. Mr. Torres made a point that I thought was very interesting and I want to follow up with him on it. I have been looking at the Foundation's 1992 awards by state and institution and there is little question that there has been a remarkable lack of looking at K through 12 kinds of institutions for potential awards. And yet, that is where science begins.

Mr. Stokes. Dr. Williams seems to want to reply to that.

Dr. Williams. The list of awards didn't indicate the all support for K through 12 activities. The majority of awards are made to the colleges and universities because they are the training sites for the teachers and the preparation of the next generation. What you are seeing is a list of the awards, it didn't answer the question.

Mr. Lewis. It doesn't answer the question but it does cause me to think that sometimes when we arrive at an institution like Congress, there is a tendency to presume that you already have all the answers so the gray matter doesn't turn very much. If the teachers just stop their learning as they leave the university, I am wondering where we are. So some of that discussion is really on point.

Dr. Massey. I think it is a good point. If I might follow up on that. We will probably get more into that, both questions. We fund mostly the places where the education and training takes place. So as Dr. Williams said, a grant that goes to a community college in Los Angeles or California State L.A., might involve teachers from a number of local elementary schools, but it wouldn't show up as a grant to the school district.

We typically don't give grants to school districts because the Department of Education and the State are usually responsible for that level. What we are doing and when we get to the E.H.R. budget we can speak more about it, we are forming stronger partnerships with the Department of Education so that the monies that they usually spend in the school districts can be in support and in alignment with NSF programs.

And maybe that we could give you data on that that would be more reflective of NSF's influence in these areas.

Mr. Stokes. Are there other additional general questions? Mr. Mollohan?

IMPROVED EFFICIENCIES AT NSF

Mr. Mollohan. Thank you, Mr. Chairman. Doctor, there are a lot of government agencies that are funded by discretionary appropriations that are going to receive cuts in funding. You may not be one of those, hopefully, but there are a lot that are. Those that will be cut will definitely have to experience belt tightening tough management decisions as well as pursuing other ways to fulfill their mission more efficiently within the restricted budget that they are going to get.

Those that are getting increases which I have heard from to date, principally the Commerce Committee are requesting increases over the Fiscal 1993 baseline. In their testimony before us, they presented a section that dealt with their efforts at internal savings, even though they are anticipating an increase. They showed how they would effect increased savings in line with President Clinton's mandate to do so.

I did not see that in your materials and I am wondering if you could speak to that. Is NSF doing a hard review of its spending and looking to see how it can effect savings even in the face of an anticipated increase?

Dr. MASSEY. Definitely. As I said earlier in response to the question of how we would manage an increase in budget for flat number of FTEs, is that we are looking at how to do business differently. We have to effect a number of efficiencies internally and we can provide you something for the record on things that we will be doing and have been doing, especially as we take advantage of moving into a new building also.

Mr. MOLLOHAN. Do you have a specific plan for that on the agenda?

Dr. MASSEY. It isn't in our book, but we have several internal working groups looking at specific areas where we can effect savings, using new technologies, how we can change the way we do business in terms of our granting process and we can apprise you with the plan.

Mr. MOLLOHAN. Would you provide it for the record, and I would also like a copy of it. Mr. Chairman.

[The information follows:]

NSF PLANNING TO IMPROVE EFFICIENCIES

NSF is currently undertaking a substantial and comprehensive review of its internal operations. A Long Range Planning Group was formed in January, 1992. This Group developed a set of five strategic themes to use as a framework for the Foundation's planning exercises: intellectual integration, partnerships, human resources, adaptability, and accountability, Internal task forces have been appointed, including the participation of a broad range of NSF staff, to review each of these themes, develop management and operation changes to meet objectives in each of the areas, and develop detailed implementation plans.

For example, the Task Force on Adaptability is charged with formulating and recommending an action plan to:

1. Reassess NSF organization, staff roles, and performance system to ensure support of evolving agency goals;
2. Increase agency focus on the use of TQM principles consistently throughout the organization;
3. Recast NSF budget and program structure to enable more rapid program response to scientific opportunities and community demands and to ensure appropriate identification of strategic research directions;
4. Identify opportunities to foster interdisciplinary work and reduce overhead costs;
5. Employ matrix organizational models as appropriate to pursue interdisciplinary research and programmatic integration; and
6. Configure NSF awards to more fully enable research and education.

The task force will develop its report by the middle of April, with recommendations for implementing potential management improvements due by the end of May. This report will be included as a basis for discussion for the planning meeting of the National Science Board in June and will be incorporated into the Foundation's long range planning efforts.

Mr. STOKES. Any additional general questions before we move to the directorates?

FUNDING STRATEGIC RESEARCH VS BASIC RESEARCH

Mr. TORRES. General questions, Mr. Chairman. There is pressure on NSF by a number of policymakers to allocate its budget to support what is known as strategic research which may contribute immediately to economic growth and other national goals. Now I agree that these pressing strategic research opportunities all warrant attention, to be sure, but how will NSF balance demands for funding strategic investigations so that basic research will not suffer comparable reductions?

Dr. MASSEY. We have looked very carefully at that. The Commission on the Future of the NSF that we formed last year addressed that and also helped us look at that and made a recommendation that we should have a balanced portfolio across what they called curiosity-based research—ideas that come from the community and strategic research initiatives. We think this budget request reflects that experience and our supplemental appropriation, if we get that, would be about half of that.

But I wouldn't want to leave the impression that within the strategic research initiatives we are not funding individual investigators. That is not true. About two-thirds of the funding, even within what we call these initiatives, goes to individual investigators. So it is not a dichotomy between individual investigators and strategic research areas.

INDIVIDUAL INVESTIGATOR GRANT SIZE

Mr. TORRES. Let me speak to that. NSF grants over the years have been reduced in size in order to provide for increasing numbers of qualified proposals and the expansion of support for other equally worthy NSF programs. I understand the average grant for an individual investigator is currently $50,000, an amount that no longer fully funds most research projects.

Do you think that the current size of individual investigator grants are adequate to maintain the level of basic research activities required to sustain U.S. research and development preeminence over the long haul?

Dr. MASSEY. No, that is a very high priority for the Foundation: to increase the size of the grants to the point they enable the researchers to do the research that they have requested. And as I said earlier, in the supplemental request, in fact all of that money if we receive it, will go to enhancing existing grants and programs.

Dr. SCHMITT. Could I add to that? If you look at the data for the past decade or so for academic research in the U.S., the growth rate of Federal support has been the lowest growth rate of the various sources of support.

Mr. TORRES. It has been the lowest.

Dr. SCHMITT. The lowest growth rate. It is still the largest factor, but the lowest growth rate. Institutional money has been growing at a faster rate than the government money. So the fraction of academic support by government has dropped from over 60 percent to about the mid–50s now as I recall. So the issue—incidentally, I should add that I don't believe that trend will continue considering the stresses of school systems and the private institutions around the country.

Mr. TORRES. Thank you.

INDUSTRIAL COST-SHARING

Mr. THORNTON. Mr. Chairman, I had not intended to ask another general question but I do want to follow up on that testimony.

As you find instances where public/private partnerships are put together to develop centers of excellence, does the Foundation seek to support the development of those centers?

Dr. SCHMITT. Well, my answer to that would be yes, absolutely they do. The engineering research centers and the science and technology centers are both designed to try to solicit the support from industry especially——

Mr. THORNTON. And what I am really getting at is where you have a philanthropist who wishes to make a major grant at MIT or at Texas or wherever, the National Science Foundation would seek to provide some help in moving a center of excellence forward.

Dr. MASSEY. Most of our grants require some kind of matching support. And, quite often, universities use it in just that fashion, to be able to bring together philanthropic support, industrial support matching funds to achieve some purpose, especially for facilities.

Mr. THORNTON. There is some feeling in elements of academia that that distorts the true academic status. I never felt so. How about you, sir?

Dr. SCHMITT. I totally disagree with that.

We have been talking about the business of technology transfer earlier. And the thing we failed to talk about is the front end of the process. Original research, creative research. Brand-new ideas can come out of interaction with real-world problems just as readily as sitting in a lab or going to professional-site meetings.

So my idea of this is getting more interaction between researchers and industry is going to enrich the arena for doing creative, original pioneering research.

Mr. THORNTON. Thank you very much, Dr. Schmitt.

Thank you, Mr. Chairman.

ECOLOGICAL SYNTHESIS AND ANALYSIS CENTER

Mr. STOKES. Let's turn to the biological sciences directorate. We know that the total for that directorate under the existing appropriations is $271,330,000, a reduction of $3 million below the 1992 level. Last year, in an exchange on page 80 of the hearings, Dr. Clutter indicated that the NSF was requesting $3 million for the establishment of a new center for ecological synthesis and analysis under the environmental biology activity.

Chairman Traxler pointed out that we could not be too confident that we would be able to deliver the 1993 budget request. Dr. Clutter noted that if the increase in 1993 above 1992 was only five or six percent that she would have to rethink this new center.

There was no increase in 1993. And, in fact, as I indicated a moment ago, there was a reduction.

We note now that you are requesting $6.5 million, more than double the 1993 request, for start-up cost of a ecological synthesis and analysis center. Did you actually start the center or are you planning to start the center in fiscal year 1993?

Dr. MASSEY. I turn to Dr. Clutter.

Dr. CLUTTER. Under all the circumstances you are absolutely correct. We did request $3 million in the fiscal year 1993 budget to start plans for the ecological analysis center. And you noted very well that we received fewer dollars in 1993 than we requested. In fact, fewer than in 1992.

We have once again requested funds for that center because it is extremely important that we start synthesizing and analyzing large data sets that now exist and doing the kind of research on that data that needs to be done for developing new paradigms for understanding new knowledge about the environment.

We began planning activities even with the reduction in our budget in 1993. We requested, I think, less than you suggest. I think we requested only an additional $1 million for that center, (which doesn't exist yet in the 1994 budget). So far we have held a planning workshop and we have plans, but we will go more slowly.

Mr. STOKES. For purpose of building where? You are planning it for 1993? 1994?

Dr. CLUTTER. Just fiscal year 1994.

BIOSCIENCES AND FY 1993 SUPPLEMENTAL

Mr. STOKES. Have you taken any actions relative to starting any new activity based on the assumption of receiving the FY 1993 supplemental?

Dr. CLUTTER. On that center? Yes, we will continue——

Mr. STOKES. Or any other directive?

Dr. CLUTTER. As Dr. Massey pointed out, we will bring our level of commitment to the cross-agency national initiatives up to the full level of funding.

Secondly, we want to augment support for our centers, the science and technology centers, so that we bring them up to the board authorized levels of funding. And we want to enhance the size of awards. So I don't anticipate making a lot of new awards. I anticipate augmenting our awards; the number of awards that we are already making.

ECOLOGICAL ANALYSIS CENTER AND FY 1993 SUPPLEMENTAL

Mr. STOKES. On the new center, do you plan to start it in 1993? Is that right?

Dr. CLUTTER. We will go out for the competition, yes. We will solicit competition for the center in 1993 if we receive the supplemental funding.

Mr. STOKES. I guess what we need to know from you, in terms of the supplemental, how it will apply to what you are planning to do with this new center. Will it impact upon what you are planning to do?

Dr. CLUTTER. Absolutely, because we can go out with the solicitation for the center in 1993 so it will speed up what we are planning to do in 1994.

Mr. STOKES. In testimony before in the subcommittee on the economic stimulus bill, the Foundation's witnesses indicated that the supplemental appropriation was virtually to the dollar going to be made available for the enhancement of existing grants rather than awarding new grants. Dr. Clutter, are you in agreement with the justification that was given to us?

Dr. Clutter. Yes, absolutely.

SUPPORT FOR CENTERS

Mr. Stokes. I wonder if we might not be sure that we are both on the same wavelength at this point.

The point that we were making last year in the hearings was that it was going to be very difficult to deliver on the 1993 requests. We felt that throughout the budget where new centers were proposed the Foundation should go forward cautiously because we didn't want center starts that could not be supported in either 1993 or 1994. The Conference Report urged NSF to start one new engineering center for manufacturing.

Aside from that, do you agree with our concern that these centers should not be started unless you have the budget to support them?

Dr. Massey. Very definitely. We have not planned it. The new engineering center—when we get to Engineering we will give you more detail. We will do this in conjunction with DARPA. That will enhance our capabilities there.

Mr. Stokes. Any questions on this directorate before we move to the next?

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Well, we were on the biological.

Looking at the computer and information science and engineering activity, you are requesting $296 million for fiscal year 1994. That compares with a current appropriation of about $215 million in the 1993 level of $263 million, assuming that the supplemental is enacted.

Last year, we asked you what the total amount was government-wide for the high performance computing activities, and you indicated about $800 million. What is the total government-wide HPCC level proposed in the 1994 budget?

Dr. Massey. Slightly over a billion; that was in the HPCC plan, is that right?

Dr. Habermann. That is right—$1,094,000,000.

ADVANCED SCIENTIFIC COMPUTING

Mr. Stokes. Let's turn to advanced scientific computing activity where you are requesting $90,810,000 in 1994. We would like to get into some detail using this activity as an example concerning how you are going to make use of the supplemental funds.

Last year, the request for this activity was $86,710,000. The 1992 appropriation was $69,430,000—And, based on our 1993 appropriation, this activity received only $69,530,000. In other words, you were level funded with 1992. You were cut about $15 million below your 1993 request.

What we would like to do, Dr. Massey, is have you take some time and give us some detail on exactly how you have taken that $15 million cut-how much has been cut from the centers, how much has been cut from new technologies, and what activities were impacted upon as a result of the $15 million cut.

Dr. MASSEY. I would ask Dr. Habermann.

Dr. HABERMANN. The cut is in the centers in the amount of $12 million, and the latter wasn't cut in the technology research program.

The flexibility that we have is in the centers. They provide services to the community at large, and training for the use of center computers. What we are doing right now is building up the machinery in an incremental fashion. The newer equipment is usually massively parallel machines that can be scaled up over time.

So, what we have done in the first place is try to push the building up of the machinery into the future. It does indeed do damage to the program, because we can't make as much progress as we would really like to see.

The other way in which we have accomplished savings is by working on a better way for the centers to share the results of their software development. In that sense we have been able to hold staff levels basically where they were and avoid what could have been an increment in personnel cost at each of the centers.

Each of the centers has a staff of about 100 people, for a total of about 400 people. Of course, an increment in personnel would require an immediate increase in the dollar amounts that we would need to spend.

Mr. STOKES. Now, the justifications also indicate that you would restore this activity to a level of $82,250,000 in the supplemental.

Dr. HABERMANN. Right.

Mr. STOKES. Roughly $11 million of the $15 million cut.

Dr. HABERMANN. Right.

Mr. STOKES. Centers would get the $11 million. And how would that be broken down?

Dr. HABERMANN. Because of the metacenter idea, we are better able to distribute the funds to the program as a whole. In the past, we basically funded the centers separately. Each comes with a separate request for machines, more or less independent of the others. With the metacenter, this is not necessary. We have a better way of spreading new equipment purchases and making them on a longer-term basis.

ADVANCED SCIENTIFIC COMPUTING CENTERS

Mr. LEWIS. Would you explain the metacenter idea?

Dr. HABERMANN. Yes. Let me first start out by telling you that there are four high-performance computer centers: One in San Diego, one at the University of Illinois, one at the University of Pittsburgh at Carnegie Mellon and one at Cornell University. Those are the four centers that—each separately started out with equipment, say, in 1988 that was very specific to their sites. There were Cray machines and IBM machines, and each center was building around its equipment.

We have reached the phase now where there is a much larger variety of high performance computers. There is a range of massively parallel machines manufactured by a number of companies that can improve high performance computing.

We have handled the problems in different ways now that there is a much wider spectrum of machinery available. No center is, of course, able to purchase all of it. What we can do is have representative machines spread out over the four centers. For instance, we have recently agreed with the San Diego center to purchase an Intel machine; in Pittsburgh, we have agreed to one of the Cray machines; and Illinois is in the process of getting a massively parallel Thinking Machine.

The center at Cornell has recently purchased a KSR machine, a very innovative architecture that works with a very large memory.

Basically what we can now do is share that equipment. The metacenter idea is the following: It is not to restrict what they can purchase, but rather that we want to try to provide a wide spectrum of the different architectures and developments that are possible. What we are trying to emphasize is that the centers can share their results.

In the past, software would be developed at one place, but wouldn't run at another place because of the different architecture. Now, because of greater emphasis on the operating system level and the software level that we call open systems, use of the same UNIX base for all centers, and developing algorithms that run on different architectures, we are able to share.

So, when graphical display technology is developed at NCSA, it becomes available for the biology work at San Diego. That is the main emphasis right now—that we are able to share results and provide computing capabilities for the metacenter as a whole.

We try to retain the connection between individual scientists and the center as far as the services are concerned; they know to whom they are talking; that the top range of computing is available; and how they can get access to algorithms. In fact, in the near future, users may not even know where their computing is done. They may do their computing on a C–90 at Pittsburgh while they physically are in Illinois.

Dr. Massey. And what makes this possible is that you are now connecting them. That was taken for granted.

Dr. Habermann. The way that we are able to do that is networking to connect these high-performance computers.

Mr. Lewis. It is a reflection of the change in technology.

Dr. Habermann. Very much so.

FUNDING FOR ADVANCED SCIENTIFIC COMPUTING

Mr. Stokes. Doctor, let me ask you, considering this appropriation will expire September 30th, how quickly can you obligate this funding and what plan is there for obligations?

Dr. Habermann. Well, since we were not able to build up the equipment at the rate that we would have liked to, that is the first thing we will now be able to do.

For example, a C–90 machine that has a small memory and a small number of processors can quickly be built up to a machine with a larger number of processors and a much larger memory. And also the equipment around it. The main computer doesn't just work by itself. It has personal computers networked together around it.

The second thing we are very interested in doing is continuing a program started in 1992 called grand challenge applications. The idea of that program is to encourage interdisciplinary work. In particular, combinations, say, of biology and computer science or geosciences and data information processing.

It was an extremely successful program. We had 246 applicants, and could only make seven awards.

The program was very well received, and really opened up the idea of intellectual integration. There were 34 additional proposals that were considered to be far and above the funding threshold, and considered to be highly meritorious.

We would have liked to make a lot more awards than we were able to do. So, we have several from last year that we can award right away.

We have already received more than 180 preproposals for this year's grand challenge applications competition. What we would like to do is double the number of awards for that program. We are pretty certain that with the flat budget we wouldn't be able to make more than seven awards this year. With the supplement, we would be able to make, say, 15 to 20 awards. That is what we are striving for.

Mr. STOKES. Was any of the $15 million increase over 1992 targeted to adding additional staff at a lot of the centers?

Dr. HABERMANN. Yes, it was. Yes.

Mr. STOKES. Would it be safe to assume that, given a level funding situation, that none of that increased staff came on board?

Dr. HABERMANN. That is essentially the case, yes.

Mr. STOKES. Would any of the $11 million restoration carried in the economic stimulus package be used to add staff at the centers?

GRAND CHALLENGE APPLICATIONS

Dr. HABERMANN. Some of that. It would be used more for grand challenge applications and for building up the equipment that was originally anticipated. A small part of it would go to staffing.

Mr. STOKES. You cannot tell us approximately how much?

Dr. HABERMANN. I would say that it is probably on the order of between half a million dollars and $1 million.

Mr. STOKES. What happens, Doctor, if this money is not made available possibly, let's say, until September because of the legislative situation out here between the House and Senate?

Dr. HABERMANN. I think we can act very quickly on this. As I said, the grand challenge application process is already going on, and the proposals are coming in. So there is no reason for us to delay that in any sense. If the money is not coming through, then we can only make seven awards. Otherwise, we will be able to fund more awards.

With the purchases it is practically the same. We have a fairly good relationship with the manufacturers. They work with us. They are interested in the software development that is taking place. They are flexible. They do not insist on payment within 30 days. So, for them, it is certainly possible to act quickly when it is certain that we have the money. The 30th of September may be a little late.

Dr. MASSEY. Not if it is not midnight. I assure you that——

OBLIGATING FUNDS

Mr. STOKES. Move the clock around.

Dr. MASSEY. If I could comment on that general thrust of the question, Mr. Kull, along with the assistant directors, has been looking at how we can make sure that we obligate funds given the uncertainty of the timing of the budget process. And we have put into place a mechanism. Given the fact that these grants are already approved—most of them—and the relationship with vendors is good, we will be able to obligate the funds.

Mr. STOKES. So then what you are saying to us is that you have an actual plan that you can show us outlining how you will spend this additional $11 million in this line item?

Dr. HABERMANN. Yes, sir.

SUPERCOMPUTER CENTER REGIONAL AFFILIATES

Mr. STOKES. The budget requests $2 million in 1994 for the creation of new regional computational training educational technology centers. Tell us why we should fund these centers and how will the funds be allocated.

Dr. MASSEY. Please.

Dr. HABERMANN. This is part of our advanced scientific computing program. We do this through our high-performance computing centers.

We have these four that I mentioned. They each have an outreach program where they make contact with their local community and where they provide the training for teachers and also for two-year educational institutions.

We have a program associated with that called the SuperQuest program in which the high schools can start competition in high-performance computing. In the summertime there are several sites where the results of the competition are presented.

SuperQuest has generated a lot of publicity, and it is very well received. It makes, therefore, access available to our high-performance computers.

Mr. STOKES. In terms of priorities, tell us how you would rank the $2 million for these new regional centers within the total increase of $9 million for fiscal year 1994 above 1993, assuming that we are talking about enactment of the supplemental.

Dr. HABERMANN. If we get the supplement, then we will be able to also allow, of course, more uses of the high-performance computing centers by other parties than just the scientists. This is very much a matter of breadth. We would like to increase the volume of the work that we do this way. If we don't get the supplement, then we have to restrict ourselves to what we are doing right now. We wouldn't be able to extend it very much to a larger contingency of mid-level educational institutions.

We think that right now we have some very nice pilot projects, but we would like to have the opportunity to broaden this. If you look at the total percentage of the institutions that we support this way, it is really few, very, very small.

Mr. STOKES. Any other questions in this area before we turn to engineering?

SURPLUS C-130

Mr. LEWIS. Briefly, Mr. Chairman.

There is a request in the geosciences area of $448.5 million, and it makes reference to $500,000 to get a surplus C-130. I know that you recall that the committee turned down a request of $2.75 million in last year's budget—in the 1993 budget. There is a wide difference in the capabilities of the jet versus the C-130. So what, exactly, is that proposal? What do you plan to do with that airplane within the work of the atmospheric research effort?

Dr. CORELL. It is part of a restructuring of an aircraft which is at the center for research. We did, indeed, request the opportunity to propose something of a G-4 class, and you urged us to work with DOD to do so. And we have been doing so.

In the process, we looked at a current aircraft that we have, which is an Electra and discovered that there was a C-130 available to us that could be transferred without cost to the National Science Foundation to enhance scientific research.

Mr. LEWIS. That was my next question.

Dr. CORELL. It provides for a very substantial increase in scientific capability to move to a C-130. So it is actually a part of a phaseout of our Electra and replacing it with a C-130. We still retain a need for higher performance aircraft that fly at higher altitudes which the jet was designed to do.

And we are not, however, asking for such authority in 1994, but are working extensively—planning and working with DOD, to see whether or not there are ways to meet our high-performance aircraft requirements that fly at 40,000 to 55,000 or 60,000 feet, which, of course, the C-130 cannot do. So this is a replacement of our existing Electra.

Mr. LEWIS. In connection with that, I have a number of questions that I could ask, but one of the fundamentals is that when you have bought the cow, then have you to feed it over the time. The Electra might be the question, but I would like to know——

Dr. CORELL. That is exactly what is being planned. This is a relatively new aircraft that has less than 10,000 hours on it, which for a C-130 is like a new airplane. They are going 100,000 hours and more. It has a lot of capability built into it that we would not, therefore, have to build. So $500,000 dollars allows us to do much of the conversion that otherwise might have cost two or three million dollars.

Mr. LEWIS. In my other subcommittee work on the Defense Committee, I spent a little time looking at that, so I may want to know more.

Mr. STOKES. Mr. Mollohan.

NATIONAL RESEARCH AND EDUCATION NETWORK AND NTIA

Mr. MOLLOHAN. Again, Mr. Chairman, I have a coordination question. I serve on the CJSJ Appropriations Subcommittee. Commerce, obviously, has a role in high performance computing and communication. I note that one of the big challenges with HPCC is to coordinate all of these programs and the various responsibilities that each of the agencies have in its implementation.

The National Science Foundation is the lead agency in the implementation of the NREN program. Commerce is also going to play a very significant role in NREN through the National Telecommunication and Information Administration's (NTIA) new program for information highway grants.

Where does NSF's role in NREN overlap with what NTIA wants to accomplish with information highway grants, and how are you going to coordinate your activities? I understand that it will be through FCCSET, could you be more specific?

Dr. MASSEY. There is a subcommittee under the FCCSET process—there are several, in fact—but there is one having to do with networking that is chaired by Dr. Habermann. So Nico can speak to that.

Dr. HABERMANN. The Federal Networking Counsel, FNC, is part of the FCCSET process. The FNC is an interagency committee that is led by the four major players in networking: the Defense Department, the National Science Foundation, NASA and DOE. Those are the four major players who have together built the internet of the U.S. part of the Internet.

The Federal Networking Council has an advisory committee that consists of representatives of both industry and the large users of networking and, of course, the government agencies.

I forgot to say that in the FNC it is not just those four that are represented. All the other agencies that have an interest in networks are also represented on it, 24 members in total.

Mr. MOLLOHAN. I didn't hear you mention Commerce.

Dr. HABERMANN. Commerce is also a part of it. I would have to look up the person who is representing Commerce.

Mr. MOLLOHAN. Maybe I just didn't hear you.

Dr. HABERMANN. The FNC has gone through a building up of programs such as security on network, and it has discussed the new implementation of the network, how it is going to grow and commercialize, privatization and so on. So we have a whole program of issues that we have been going through.

Now, the question of the NTIA came up fairly recently. So what we have done there is the following: In the HPCC committee that is chaired by Don Langberg——

ROLE OF THE NATIONAL TELECOMMUICATIONS AND INFORMATION ADMINISTRATION

Mr. MOLLOHAN. The question would be, what is NTIA's role?

Dr. HABERMANN. What was the relationship between NTIA and the NREN program?

Mr. MOLLOHAN. And that is what you are speaking of?

Dr. HABERMANN. We raised that question. And it was about a month ago that we raised it for the first time. We had one representative for the Commerce Department and someone from OSTP briefing the committee on the issue of what the NTIA program was all about. That was the first contact that we had to discuss how the two could cooperate.

We had a meeting at OSTP two days ago in which the representatives of the NTIA program came together with representatives of the NREN program to build up the connection between the two of us.

We have not formulated a plan yet. It was really a getting-acquainted meeting, to get to know each other and better understand what the respective interests were.

We came to the conclusion that there are already several possibilities, many possibilities where we can work together. One example is the program that we just were discussing—the way that our high-performance computing centers work together with highschools. The NTIA is going to look at that and see if they can use it as a model for what they want to do.

We also discussed the type of equipment that they would like to place into schools and we estimated how much that would cost.

I would say that we are at the point of making the first contact. We have not set up a formal plan yet, but I am pretty sure that the connection will grow into a more formal arrangement in which we can work together.

Also, I am very certain that NTIA can make use of the work that has been done in the NREN program and build on top of that.

Mr. MOLLOHAN. Thank you.

Mr. STOKES. Mr. Torres, any questions?

Mr. TORRES. Are we still on the advanced scientific computers?

Mr. STOKES. Yes, we are.

Mr. TORRES. I have no other questions.

Mr. STOKES. Off the record. We are recessed to 1:30 p.m. this afternoon.

AFTERNOON SESSION

EARTHQUAKE HAZARD PROGRAM

Mr. STOKES. The committee will come to order.

Dr. Massey, turning to engineering, you requested $323,000,000 in 1994. That is an increase of about $82,000,000 over the current level of roughly $26,220,000 above the revised level, assuming the enactment, of course, of the supplemental.

Turning to the biological and critical systems subactivity, I note you are requesting $17,480,000 for the Earthquake Hazard Mitigation Activity in 1994. Last year you requested $17,600,000 and we asked if that program needed to be restructured, whether it was well focused.

Dr. Bordogna responded that the Earthquake Hazard Program was well focused and sailing along fine. I note this is an activity where the Foundation chose not to reflect the committee's level of funding for NSF for 1993. In fact, you cut earthquake hazard mitigation by $2.3 million below the 1992 level.

If the program was as successful as was prescribed last year, why was such a deep cut made in 1993?

Dr. BORDOGNA. Our program is very successful and very important and it also represents half of total civil engineering research at NSF, which is an important measure of its importance. We are reorienting the earthquake program toward an overall civil infrastructure systems program because much of the research being done is very critical for the design of buildings generally.

We also had a windfall because the Federal Highway Administration has awarded $14 million to the New York Center for the specific purpose of highway renewal so that highways can withstand earthquakes better. This is very much in the context of an overarching, growing strategic program.

Mr. STOKES. Well, if we include the stimulus supplemental, this activity barely makes it back to the 1992 level. Isn't that true?

Dr. BORDOGNA. Except one million of that program was scheduled about four or five years to come out of the Center funding at this point. One million is automatic. There are two major features. One is to bring that into the agenda, see that it is applicable, and the second is that it has attracted funds from another source in the government.

ENGINEERING EDUCATION AND CENTERS

Mr. STOKES. Let's turn to engineering education and centers subactivity. I note you are requesting $52,500,000 in 1994. This compares with $47,500,000 in the current 1993 budget, which was level funded with 1992; is that correct?

Dr. BORDOGNA. Yes.

ENGINEERING RESEARCH CENTERS

Mr. STOKES. All right. In level funding this program for 1993, how are you accommodating without any supplemental funds the initiation of one new ERC for manufacturing?

Dr. BORDOGNA. The ERC program has not for three years had a Center and we are very anxious to try to get to the 25 that has been the measured goal for many, many years now. There are five Centers approaching the 11-year point for recompetition and in those programs the budgets for the last couple of years are waning. Thus, there will be some money freed up, and we are attempting very much to fund another Center that way.

Mr. STOKES. What is your current number of ERCs?

Dr. BORDOGNA. Eighteen.

Mr. STOKES. That is the number we are funding today, right?

Dr. BORDOGNA. Yes.

Mr. STOKES. The justifications indicate that you want to start two additional ERCs in 1994. Is that over and above the one planned for new start in 1993?

Dr. BORDOGNA. No. That is the total. We are trying in some ways to make sure we start moving toward the 25.

Mr. STOKES. Are you talking about one and one then?

Dr. BORDOGNA. One and one.

Mr. STOKES. Each year we ask you what ERCs were undergoing review, but as I understand it the ERCs that underwent review last February and March included Brigham Young and was it Illinois, Carnegie-Mellon, and Lehigh?

Dr. BORDOGNA. That is correct.

Mr. STOKES. What was the outcome of those reviews?

Dr. BORDOGNA. They have been renewed. All have come out successfully.

Mr. Stokes. Now, to date, I believe three Centers have been shut down.

Dr. Bordogna. Yes.

Mr. Stokes. Do you plan to shut down any additional ERCs during the balance of fiscal year 1993 or 1994?

Dr. Bordogna. No. Of the original six, there are four remaining that are beginning to approach the 11th year and will be recompeted. Up until that point, it is not likely anything is going to happen with those ERCs.

Mr. Stokes. Are you telling us that nothing will happen until 1995?

Dr. Bordogna. Well, the next review is really of the four original ones and that is because they will be approaching their 11th year in 1995. They will recompete then. Until then, I don't think any of those are going to shut down.

Dr. Massey. But that is the next review, that is the question.

ENGINEERING RESEARCH CENTERS

Mr. Stokes. Right. What Centers will get the additional $2.5 million that you are proposing in the economic stimulus package?

Dr. Bordogna. We have a couple of things we want to do there. The most important is to enable the present Centers to better do their job. Presently they really aren't funded sufficiently to enable them to carryout what we all hope they can do with extra equipment or other funding; for example, technician support. This is related to defense conversion where there will be defense technicians displaced, as well as engineers. There is a great need in academia for technician support because of the complicated application of technology to research and ERCs particularly, so we expect to invest most of that money to bring the present ERCs up to their capabilities.

Mr. Stokes. How many additional jobs would you anticipate would come about as a result of this?

Dr. Bordogna. It is a hard question to answer. There are going to be jobs generated a number of ways. If we buy extra equipment, then there will be people at work making that equipment. There will be technician needs, probably six to 10 people there I would say, minimally, for the amount of money we have to invest.

Mr. Stokes. You are talking about each Center now.

Dr. Bordogna. No. We are going to focus on Centers particularly that need the money most to get the job done, and the job to be done, of course, is to make sure that we are connected with industry, helping to ensure that the nation is getting fresh products out into the marketplace. We don't have the money yet. If we do, we quickly know where the needs are, and then we will focus on doing that.

Mr. Stokes. All right. What we are trying to get at, I think, is the number of additional jobs that will be created through that $2,500,000. If we are talking about 10 jobs——

Dr. Bordogna. I can't answer that because we haven't given thought to exactly how many jobs would be enabled by this, but certainly that is the focus of where we are going to make the investment.

INDUSTRY-UNIVERSITY COOPERATIVE RESEARCH CENTERS

Mr. STOKES. You are requesting an increase of $2,000,000 for a total of $9,200,000 for the industry-university cooperative research centers.

Over the years NSF has established 50 of these Centers. The program was built on the expectation that the NSF's initial support would ultimately be replaced with industry support and the Centers within five years will become self-sustaining. How well has this concept worked?

Dr. BORDOGNA. The industry-university cooperative research program has probably been one of the best in terms of leveraging industrial resources because for every $50,000 invested by the government, there is a total of $500,000 being used at these Centers. So these have been very, very successful. These are Centers that industry really likes very much because the integration of the Centers responds to the specific need of industry in the community. They are very much tied, again, to what the local economy may be as determined by industry. Said another way, but industries cooperating with the universities up front determines the research being done. There is no plan to close these—all these are going very well. We like them very much and what we have done now is to add a State component, coupling with State initiatives in local economic development. In fact, the supplement will allow us to implement immediately another State ERC because we have a worthwhile proposal in hand which we didn't have money to fund.

Mr. STOKES. How many of the 50 are self-sustaining?

Dr. BORDOGNA. I don't know. We will have to look at that, but I think you want to keep in mind that a $500,000 Center with $50,000 from NSF is almost self-sustaining.

Mr. STOKES. The basis for our question is that they are supposed to become self-sustaining after five years under the concept that we discussed earlier and some of them have already attained that status; isn't that correct?

Dr. BORDOGNA. I guess we are still doing that. We will have to analyze——

Mr. STOKES. You want to provide that for the record for us?

Dr. BORDOGNA. Yes.

[The information follows:]

SELF-SUSTAINING INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTERS

The Industry/University Cooperative Research Centers Program generally funds $50,000 per year to Centers for the initial five years. These "seed funds" are leveraged at a minimum of six to one from other sources at the start. Most Centers grow during the initial five years and usually far exceed a leveraging of ten to one.

After the initial five years, experience has shown that a Center will lose some of its industrial support when NSF ceases to be an active component of the Center. Company management's typical comment is "If NSF is dropping out of the Center, we should too." Since the leveraging of NSF funds is very high, the funds involved are relatively small, and to avoid the detrimental image of NSF "dropping out", the Program developed a "Self-Sufficient Partnership for Research" Initiative. This initiative provides funds for basic research in the Center and eliminates the NSF "dropping out" image. The Center funding for this initiative is to be equivalent to a company membership in the Center (between $25,000 and $50,000/year). In addition, the initiative: (1) continues NSF support of basic research, (2) fosters university/industry interaction, and (3) provides the important mechanism to develop interagency interactions.

CENTERS WITH SELF-SUFFICIENT AWARDS

University of Massachusetts, Dr. S. Kantor, Polymers Research; North Carolina State University, Dr. G. Abbott, Telecommunications; Rutgers University, Dr. D. Niesz, Ceramics; Georgia Institute of Technology, Dr. I. Pence, Materials Handling; Pennsylvania State University, Dr. J. Dougherty, Dielectrics; Colorado School of Mines, Dr. G. Krauss, Steel Processing; University of Washington, Dr. B. Kowalski, Process Analytical Chemistry; New Jersey Institute of Technology, Dr. R. Magee, Hazardous Waste Management; University of Arizona, Dr. N. Peyghambarian, Optical Circuitry; Northwestern University, Dr. H. Cheng, Engineering Tribology; University of Arizona, Dr. J. O'Hanlon, Microcontamination & Control; Carnegie Mellon University, Dr. R. Fruehan, Steelmaking; Northeastern University, Dr. M. Silevitch, Electromagnetics; Lehigh University, Dr. A. Bean, Innovation Management; Iowa State University, Dr. D. Thompson, Nondestructive Evaluation; Oklahoma State University, Dr. K. Reid, Web Handling; Lehigh University, Dr. C. Georgakis, Process Modeling & Control; Alfred University, Dr. D. Pye, Glass Research; University of Texas, Arlington, Dr. O. Mitchell, Advanced Electron Devices; University of Tennessee, Dr. A. Garrison, Measurement & Control Engineering; Rutgers University, Dr. R. Saba, Plastics Recycling; New Mexico Institute of Mining, Dr. P. Persson, Energetic Materials; University of Florida/Purdue University, Dr. R. DeMillo, Software Engineering; University of California, Berkeley, Dr. R. Muller, Integrated Sensors; and North Carolina State University, Dr. K. Swartzel, Aseptic Processing.

INDUSTRY-UNIVERSITY COOPERATIVE RESEARCH CENTERS

Dr. MASSEY. I think, Mr. Chairman, what has happened over the years is that the program proved to be much more successful than we might have thought in terms of leveraging finances and, in fact, the goals have changed. The $50,000 is a modest commitment in terms of the whole amount of money, but it gives it an NSF presence.

In looking at these centers, what we have found in attracting industrial money is that having an NSF presence is so important that, in fact, I think it is honest to say that the goals of pulling out completely have really changed. We can address that more fully in a written response.

Mr. STOKES. All right.

Dr. MASSEY. That is true.

Mr. STOKES. Let me ask you this: Are you actually seeing these centers successfully transitioned to industry-supported research?

Dr. MASSEY. Yes. If you accept our position that a 10 to 1 ratio of funding really means that they are industry supported, not NSF supported, because NSF is a minor player. It is more like having the NSF imprimatur in involving it with the program that is making it successful.

GEOSCIENCES SUPPORT

Mr. STOKES. Let's turn to the Geosciences Directorate. There you are requesting $448,530,000 in 1994. That compares with the current level of $379,780,000 and an enhanced level, assuming the passage of the supplemental, of $421,000,000.

The Geosciences Directorate was afforded, within your own priority judgments, essentially level funding in 1993, which tracks the committee's overall appropriation. What has been the impact of level funding on this area?

Dr. MASSEY. Dr. Corell can speak to the details.

Dr. CORELL. Immediately after the appropriation bills were passed, we obviously sat down and figured out how to implement the recommendations and we made some major priority decisions. For example, we felt very strongly about the initiative to develop the Hydrologic Science Program, which is a very essential program based on the National Academy of Sciences recommendations. We chose to do that. In fact, it was funded at the $2.5-million level request and we made a number of those sorts of priority decisions in terms of our long-range strategic planning.

That meant we had to cut back in some other areas and we did, in fact, do that. In some areas the reductions were as much as 10 or 12 percent. In implementing the FY 1993 Appropriation we tried very hard to maintain the priorities that we reflected in our budget request, but did it as an essentially level budget.

OCEAN SCIENCES

Mr. STOKES. I note that the ocean sciences element of Geosciences received the largest increment, roughly $18.5 million in the economic stimulus bill. Was that increase all associated with the global change program or are there other factors involved?

Dr. CORELL. Because oceanography played such an essential role in the mid 1990s in implementing field programs to understand the role that the ocean plays, that increase in funding was essential to maintain those priorities and hence we did so.

ARCTIC RESEARCH VESSEL PROCUREMENT

Mr. STOKES. As I recall, last year you had included in the original 1993 request about $2.5 million for the initiation of either a purchased or leased Arctic research vessel. Was that $2.5 million number correct?

Dr. CORELL. It was reduced to $1.5 million.

Mr. STOKES. We want to know if the $2.5 million is correct.

Dr. CORELL. For this year?

Mr. STOKES. 1993 request.

Dr. CORELL. It was $2.75 million. I am sorry I misunderstood.

Mr. STOKES. All right.

I now note you are requesting $6.5 million for what you describe as, quote, "long lead time government furnished scientific equipment and to initiate procurement of the Arctic research vessel through charter or purchase," close quotes.

Do I understand from the tight budget in 1993 you did not allocate any funds for the Arctic research vessel?

Dr. CORELL. That is not correct. In 1993 we have $1.5 million available to us.

Mr. STOKES. That is what the conference report gave you.

Dr. CORELL. Yes. Those dollars are invested in the continued design phase of the vessel. We have naval architects under retainer. We are working with the scientific community to be sure the scientific goals and objectives and design are consistent. The primary request for long lead time and initial steps in the procurement are in 1994.

Mr. STOKES. We want to ask you about the dispute going on within the Foundation, and that dispute has come to the Hill through a lobbying effort, whether this vessel should be purchased or leased.

We asked for an analysis of it some two years ago and I am not sure there was any definitive conclusion in that analysis.

We would appreciate it if you would take some time and run through the pros and cons with us, giving us both sides of the argument fairly, which looks to be the most economical to the government and so on, and tell us in what direction you intend to proceed.

Dr. CORELL. We can supply a more detailed report for the record, but the simple statement is the Congress in the final appropriations encouraged a lease or lease-purchase. We are not entertaining a direct purchase of this vessel in our request.

ARCTIC RESEARCH VESSEL PROCUREMENT

Mr. STOKES. I guess what we are trying to get at is, realizing what you have said is correct, but we are trying to get at your views pro and con on it so we can understand the issue.

Dr. CORELL. On purchase versus lease-purchase?

Mr. STOKES. Right.

Dr. CORELL. As you know and you mentioned, we were asked to conduct a study. We did do that in accordance with regular OMB circular standards and came to the conclusion that as long as the return on investment, not even return discount rate, I should say, is 7.5 percent, it is in the best interests to the Government to do a lease or lease-purchase arrangement for the short term. That report was supplied to the Congress about a year ago, but we can give you an update on it and a 1993 view of that study.

We have proceeded, following the appropriations last year, with all of our planning to operate on the basis of lease or lease-purchase. The basic arrangement is a two-step process. The first step is to select an institutional or institutional consortia operator of the vessel and have the procurement of a vessel be done by that institution or consortia under standard government procedures for acquisition.

This is precisely the arrangement we have used in all acquisitions of oceanographic vessels, both by ONR and NSF. So there is a long history of this kind of arrangement. The only difference in this procurement is that there will be the overlay that it will be a lease or lease-purchase arrangement rather than outright purchase.

Mr. STOKES. Well, feel free to expand on it in the record.

Dr. CORELL. We will give you a more comprehensive report on that vessel.

DIFFERENCE BETWEEN LEASE AND LEASE-PURCHASE

Mr. STOKES. What about whether or not there is any difference between a straight lease and a lease purchase? Is there a difference or significant difference?

Dr. CORELL. If you do a straight lease at the end of the lease period, that vessel returns to the owner of the lease. If it is a lease-purchase, then at the end of the lease period, we own the vessel, we, the United States Government.

Mr. LEWIS. That is, you have the option to purchase.

Dr. Corell. You can either have it run out so at the end of the period it is yours or there may be a balloon at the end at which you buy out at X millions of dollars. Those details are always given to us in the proposals that come forth from the construction company or the operator.

Mr. Stokes. Which of those do you think is more feasible in terms of the government?

[The information follows:]

Arctic Research Vessel Procurement

The U.S. has the capability required to work in all open water regions of the world including the Antarctic, which uses the research ship NATHANIEL B PALMER, but needs modern capabilities for performing scientific research and education in the Arctic. The acquistion of an Arctic research vessel is a high priority for completion of oceanographic facilities needed by the academic and government laboratory research programs.

In response to the FY 1992 House and Senate Appropriation, NSF has provided cost-benefit analyses of various options for acquisition and procurement of an Arctic research vessel, for a full 20-25 year life cycle which indicate that the least cost option is to provide federal funds upfront for the direct purchase of the vessel. This, however, requires substantial federal funds in the short term rather than over the "life cycle" of the research vessel. Because key variables affecting the degree of cost savings may change before acquisition is completed, direct construction with institutional funding, lease-purchase, and charter lease options should be pursued.

Studies recommend the Arctic research vessel be operated by an academic institution or consortia of institutions to determine the mission of the vessel in response to the evolving needs of oceanography. Operations must be efficient and flexible in meeting changing research and educational requirements inherent in the conduct of science. Additionally many institutions provide a degree of cost-sharing which further reduces the cost of vessel operations to the federal government.

Since NSF is not a ship operating agency, the U.S. academic research fleet is managed and operated by oceanographic institutions or university consortia, all of which have active research and educational programs and provide community-wide access to their facilities. NSF will accept proposals from university-based groups to become the institutional operator for the Arctic research vessel. The institutional operator will (i) acquire, through competitive bids, a suitable vessel and (ii) provide marine operations, logistical and technical support for the vessel. Significant factors for selecting an operating institution are: (i) a procurement and operating plan that responds to evolving needs of oceanography, (ii) a management strategy that takes advantage of the evolution of new techniques and advanced technology, and (iii) a realistic and practical financial plan that provides for cost effective operations and provides institutional support for infrastructure requirements (docks, buildings, etc). The institutional operator must conduct an open competition to the shipbuilding industry for an Arctic research vessel that meets the scientific research priorities and fulfills the ship capabilities and performance requirements.

The bid package by the institutional operator must include both lease-purchase and charter lease options in addition to any direct construction options using institutional funds for an "American-built" ship. The most advantageous financial and management proposal, consistent with available funds, will be selected.

The Arctic research vessel is now in the conceptual design phase, which will provide cost estimates for construction. The planned completion date of this effort is in late FY 1993.

Attached is a short paper entitled "Research Ship Acquisition and Operation modes" which summarizes the advantages and shortcomings of direct construction, lease-purchase and lease options for academic research vessel procurement. In summary, it concludes conventional design, construction and operation of academic research ships is most likely to lead to effective and cost-efficient science at sea. Lease-purchase and lease arrangements will be more difficult, which is explained in the paper, but with appropriate participation by the sponsor (NSF), operator (university or university consortia) and users (research scientists) these approaches are feasible.

UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

FLEET IMPROVEMENT COMMITTEE

Department of Oceanography
Texas A&M University
College Station, Tx. 77843

29 January 1988

Memorandum

To: Donald F. Heinrichs, Section Head, Oceanographic Facilities and Ships, NSF/OCE

From: Worth D. Nowlin, Jr., Chairman UNOLS Fleet Improvement Committee WDN

Subject: Research Ship Acquisition and Operation Modes

Your letter of 7 August 1987 asked the UNOLS Fleet Improvement Committee to examine, from the science operators viewpoint, different methods of research ship acquisition and operation. The Committee discussed this matter at a subsequent meeting and charged Richard Barber to prepare a draft statement. These comments are based on that draft and comments thereon after committee review. Members of the Fleet Improvement Committee will again review this statement at the March 1988 meeting, and any further thought will be provided to you then.

BACKGROUND: The NSF long-range plan for ocean science requires the acquisition of new, more capable vessels to replace aging ships. Science Mission Requirements developed for all classes of vessels emphasize improved sea-keeping, higher performance, improved over-the-side gear handling capability, and modernized shipboard laboratories.

There are several options for acquiring new research ships, each with its own advantages and shortcomings:
--New construction
--Lease of new construction by private industry
--Lease-purchase of new construction by private industry

THE DESIGN PROCESS: Regardless of the method of acquisition, it is vital that the design process be kept under tight control by the sponsor, operator, and users. Indeed, unless the ship is designed to carry out the science adequately, the other parts of the acquisition process become irrelevant. This means that the design should be very carefully developed to meet the Science Mission Requirements which have been specified, and close supervision of the architect and builder will be required.

Advantages of carrying out construction "by NSF" as has been done in the past is exemplified by the OCEANUS class, in which the group which developed the concept was also the controlling party during the stages of final design and actual building. On the contrary, if a ship is to be leased or lease-purchased from industry, there would be incentive for the builder to produce a generic ship which would be leasable to other users, if NSF does not accept it or does not continue the initial lease. It is believed that this can be overcome to a large extent by clearly specifying ship characteristics, and assigning sponsor and operator personnel to oversee the final design and construction phases.

Lease-purchase would give the sponsor a stronger hand in this process, since he has a financial stake in the ship via final acquisition. The builder too would certainly be influenced by this arrangement, and should be more willing to provide a ship which would be satisfactory enough to be eventually taken off his hands by the leasor.

In the case of simple leasing, the motivation for the builder to meet specific user requirements would not be as strong, because the option to drop the lease exists as a constant threat. However, even in this mode, the builder would be motivated strongly to provide a ship which would lead to a long and profitable lease, and in the soft maritime market of today this would be a major incentive.

In general, then, users are probably most likely to get an "ideal" ship via outright new construction; slightly less likely under lease-purchase; and still less likely under direct lease. However, given proper contract development and active participation by sponsor and operator during the design and construction process, it should be possible to acquire a satisfactory ship by any of these modes. In support of this view one can review the numerous cases over the last 25 years in which research has been done from vessels which were wholly leased (NavOceanO's acoustic surveys or chartering by individual scientists of available commercial hulls when UNOLS ships were not available), or in which generic hulls were adapted to use as research ships (GYRE, MOANA WAVE, and NEW HORIZON).

It is emphasized that in the case of lease or lease-purchase, involvement by sponsor, operator, and users will have to be much more pervasive than for direct agency new construction. "Performance specifications" will by no means be enough to assure adequacy. For example, to say that a ship must accommodate twenty scientists leaves an unacceptable margin of discretion as to the quality of the facilities. Similarly, "X square feet of laboratory space" is insufficient, unless the location, layout, access, environment, services, and so forth are optimized. While one cannot dictate to the designer and builder the details of the ship, it can be made abundantly clear that if not properly built, it will not be acceptable.

CONSTRUCTION: Regardless of the acquisition process selected, the ship, in addition to being suitable scientifically, must be soundly built and in full compliance with the minimum standards of Subchapter U CFR and other pertinent regulations. Because these same regulations apply to the use of a ship for research by any user, it would be to the builder's advantage to comply with them. Nevertheless, it should be specified that the ship must be built in accordance with the provisions of pertinent regulations as a minimum and oversight during the construction process must be provided. Because the institution which is to operate the ship will have to live with its safety and operability, it should be intimately involved during construction.

As with the design process, it can be assumed that construction via lease or lease-purchase would complicate somewhat the process of assuring compliance with the desires of the ultimate user. However, with properly-drawn agreements, a clear understanding by all parties of what is needed, and close supervision during the building, a satisfactory product should result. Key to the success of this will be a firm understanding of who has ultimate control on behalf of the sponsor/operator/users, to ensure that required oversight is get carried out and that disagreements not arise at critical times.

OPERATION: While operation of the ship is not strictly speaking a function of the acquisition process, it should be touched on since many ships leased for research in the past have had commercial operating crews. Use of this mode of operation for a general-purpose, full-time academic research ship would be a fundamental change from traditional U.S. practice. There is no question but that such a contract crew could provide excellent support for a single-mission technical ship; commercial geophysical services companies do it routinely. However, the institutional operating crews provided by universities, and the marine operations, logistical, and technical support which accompany them, combine to make up an extremely knowledgeable and effective structure which academic scientists have found generally responsive and are comfortable with. To achieve this sort of competence with a commercial operating crew is possible theoretically, but likely difficult to achieve in practice. In effect, use of a commercial operating crew would require each science project to develop its own operating and logistics infrastructure. To see this system in operation one should look at the management and crews of commercial general-purpose technical ships or (at worst) military or quasi-military crews. Unless there is some overriding reason to change, the operation of academic research ships should be continued in the manner which has worked well for many years.

SUMMARY: It is to be expected that conventional design, construction, and operation of academic research ships will be most likely to produce results which will lead to effective and cost-efficient science at sea. However, if circumstances dictate that ships be acquired via lease-purchase this should be entirely feasible; accomplishing it by pure lease will be somewhat more difficult. In both cases there will be increasingly detailed participation by sponsors, operators, and users during the entire process, and this would likely increase costs somewhat as well. Post-construction operation of such ships by charter crews would also be possible in theory, but would certainly be much less satisfactory than the use of institutional crews and supervisory, support, and logistics structures.

xc: UNOLS Fleet Improvement Committee
G. Keller
W. Barbee
R. West
K. Kaulum

UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

An association of institutions
for the coordination and support
of university oceanographic facilities

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February 8, 1988

To: Worth D. Nowlin, Jr.
Chairman, UNOLS Fleet Improvement Committee

From: William D. Barbee
Executive Secretary, UNOLS

Subject: Research Ship Acquisition and Operation Modes

I have received and reviewed your 29 January letter to Don Heinrichs, response to his request for assessment of ship acquisition modes.

I found the FIC analysis to be excellent and was particularly heartened to see a section on Operations which advocated the current mode of ship operation by academic institutions. I would like to suggest, however, that remarks on Operations be expanded to encompass an additional point. I believe firmly that an effective marine operation/ship operation brings important benefits to an academic ocean research institution beyond those of simple facilities support. Thus, could you consider adding to the Operations sector something like the following.

Further, the effective discharge of marine operations and related support bring benefits far beyond effective facilities support to an academic institution engaged in oceanographic research. Ship operations are among the few and are, perhaps the most important of integrating factors at oceanographic research institutions. The maintenance and improvement of good ship operations benefits all disciplines, every ocean investigator in the department, thus focusing the whole research endeavor. Ship operations are among the largest and most stable elements of the research endeavor, and thus lend stability to a university's ocean program. (The arguments could go on.)

WDB/mjh
cc: R. Barber
G. Keller

Dr. CORELL. I think it is unclear at this time. I think there are arrangements in which a lease arrangement such as we have in both our ships that work in the Antarctic, such as the Nathaniel B. Palmer, are straight leases. We are aware of other arrangements in which consortia are looking at lease purchase arrangements. It almost looks like a mortgage arrangement rather than a lease.

Let me give you an example. We were before this committee some years ago with a ship that is now at Lamont-Doherty Earth Observatory at Columbia University. That vessel was bonded by the State of New York for a seven-year period and during that period of time, we, in concert with the University, are both paying the operating costs and fulfilling the mortgage requirement.

At the end of the bonding period, the vessel will be owned outright. But until the details of specific proposals are known, it is hard to make a judgment of what is in the best interests of the government. No matter what, the scientific agenda will have to be addressed equally well by either type of proposal.

Mr. STOKES. If we are forced to again level fund the foundation in 1994, would you proceed with this vessel?

Dr. CORELL. No.

Mr. STOKES. Will this new vessel be built in a shipyard located in the United States?

Dr. CORELL. If that is the guidance we receive from the Congress, with the FY 1994 Appropriations report.

C-130 AIRCRAFT CONVERSION

Mr. STOKES. Earlier on, Mr. Lewis sort of discussed this question with you, but let me go into it a little further.

Last year the budget proposed $2.5 million towards the acquisition of a new research aircraft for the National Center for Atmospheric Research. What was the total anticipated costs of that airplane?

Dr. CORELL. It is in the $20 to $25 million area.

Mr. STOKES. Now, again, owing to budget problems, we did not support that request. But, of course, you are coming back to us now with only $500,000 for the purchase of a surplus C-130 for conversion to research purposes.

Bring us up to date on that and tell us the comparative total cost of the C-130 approach, including conversion and outfitting, as compared to the new airplane that you had proposed last year.

Dr. CORELL. As a consequence of our discussions with you last year, we have during the past year taken a good, hard look at the total fleet of aircraft operated by NCAR, which is basically the fleet we have to support the atmospheric scientific research. It is composed of four airplanes, one of which, the Saberliner, we are going to retire. It is a small airplane and worth about $400,000, and we would intend to obtain $400,000 for the sale of the airplane and use it for maintenance upgrade of existing airplanes.

We came to the conclusion that it is time to also seriously consider retiring the Electra, which is the main aircraft of the fleet. It is a large aircraft, like a P-3, well instruments, done yeoman service, but it is in excess of 20 years old. After our discussions with DOD on your counsel last year, we learned of opportunities, and one that came up that was a surprise, actually, was the availability of this electronic venture C–130 designated EC–130–Q that has a relatively few hours on the air frame—8,000 or thereabouts—and it became clear we ought to upgrade that airplane.

That is what the $500,000 is for—to renovate that aircraft for scientific purposes and then phase out the Electra. This still leaves, in a sense, a hole in our ability to do above around 35,000 to 40,000 feet because C–130s just don't do above about 40,000. In fact, you are pressing them to get that high.

We did, however, run some experiments with DOD to see if we couldn't get that high and we have determined that for some 3 or more hours you can, in fact, fly at those heights. So we are going to sacrifice some of the capability that the Saberliner has in altitude in exchange for endurance of the C–130.

We are exploring with DOD right now, particularly the Air Force, the possibility of some higher performance airplanes to work in the 40,000 to 60,000 foot category.

I don't know the outcome of this. We have identified an airplane and we are going to do a very serious technical analysis of the aircraft to see over the next three to five years if that airplane could serve some of those higher altitude requirements particularly driven by global change interest and need to work in the lower stratosphere or upper troposphere and also to support our weather research program that is done, as you know, with all the other relevant agencies in government.

What I would call this is an interim solution that will eventually require performance aircraft of the type that G–4 provides, but we are not requesting support for that this year nor do I anticipate it in the near future. But several years out we will revisit that question with you, with one exception. That is, if we really can't get that performance through DOD acquisitions, we may come back and talk to you about how we do that otherwise.

C–130 CONVERSION

Mr. STOKES. Let me ask you this in terms of clarification. Is the total cost for the C–130 we are talking about $500,000?

Dr. CORELL. Roughly. We will probably have to invest a few hundred thousand here and there over the next several years because we are getting this aircraft from DOD at no cost to the National Science Foundation, none. So we are picking up a $30–$40 million airplane to help us with this need. But there will always be some upgrades because you don't do all the renovations you need the first year, but we are not likely to see a $2 or $3 million request for major changes, because she has a lot of electronic systems in her which when we remove still provide the pathways for wires and power.

Mr. STOKES. Did you have any questions?

Mr. LEWIS. No. You are doing fine, Mr. Chairman.

MATHEMATICAL AND PHYSICAL SCIENCES

Mr. STOKES. Under the Mathematical and Physical Sciences Directorate, you are requesting $718,390,000. That represents a $100 million increase over the current plan of $619,940,000, and a nearly

$58 million increase over the revised plan assuming the passage of the supplemental.

MAJOR RESEARCH EQUIPMENT

Now, we have been warning the agency for some time, but without much effect, that as you continue to propose these major research projects, such as the Laser Interferometer Gravity Wave Detector, and the eight-meter telescopes, and so on, if the budget remains at level funding, these projects will take on a political life and be relatively impossible to cut, eliminate or downscale. Past LIGO experience demonstrates that is exactly what has happened.

Would you agree with that?

Dr. MASSEY. Yes, Mr. Chairman. It took me two years to learn that.

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY (LIGO)

Mr. STOKES. Do I understand correctly that the current 1993 operating plan includes $20 million for LIGO?

Dr. MASSEY. Yes, sir.

Mr. STOKES. Do I understand correctly that it will be your proposal to add an additional $8 million to that activity in 1993 regardless of whether the supplemental plan is enacted?

Dr. MASSEY. That we are committed to add up to 8 million, given the satisfactory progress on the project, yes.

Mr. STOKES. And do we understand correctly, you are requesting $43 million for LIGO in 1994?

Dr. MASSEY. Yes.

Mr. STOKES. Is that what the LIGO team originally anticipated, or is it more like $50 million plus?

Dr. MASSEY. It was more like $50 million, but after review of the project, given the funding in 1993, they have a plan together for that $43 million request.

NASA GRAVITY WAVE DETECTION PROJECT

Mr. STOKES. Let me ask you this: Are you aware in the very near future gravity waves may be discovered by NASA using three planetary spacecraft?

Dr. MASSEY. No, I am not really. Are you, Bill?

Dr. HARRIS. My understanding is that quite some time in the future, that is a possibility.

Mr. STOKES. Let me ask you this: Do we understand correctly that the reason, in fact perhaps the sole reason for building LIGO is to discover gravity waves which were predicted by Einstein?

Dr. MASSEY. I'm sorry?

Mr. STOKES. To discover gravity waves.

Dr. MASSEY. Yes. To discover and use them as a tool.

Mr. STOKES. Excuse me one moment.

The question we posed to you earlier was, based upon a NASA news release on March 17th, 1993 entitled Three Spacecraft to Conduct Three-Week Gravitation Wave Search, and in here, they say, "The joint NASA-ESSA experiment will run from March 21st to April 11th, marking the first time three spacecraft will make observation simultaneously, greatly increasing the reliability of any detection."

And then quote, "If this experiment succeeds in detecting gravitation of waves, it may answer fundamental questions about the nature of gravity as well as give further support for Einstein's theory of general relativity," said Dr. Robert Stachnick, gravitation wave program scientist in the NASA Astrophysics Division, Office of Space Science, Washington, D.C.

Dr. MASSEY. Just hearing that, I suspect what they are saying, gravitation waves have already been observed—not observed directly, but we have indirect evidence that they exist. And this experiment may add to that. But that experiment will not be able to actually measure any properties of gravitation waves over the extended period, if I understand what they are doing. But I must admit I am not familiar with that. Are you, Bill?

Dr. HARRIS. No, sir.

Mr. STOKES. You will take a look at that?

Dr. MASSEY. Sure.

GEMINI 8-METER TELESCOPES

Mr. STOKES. All right. Let's turn to another subject. Let's talk about the eight-meter telescopes.

I think it is fair to say the committee has been more than generous in granting extensions to this program to permit the Foundation and the astronomy community to have a maximum opportunity to achieve a 50 percent participation from international partners in order to build both telescopes: One in Hawaii and one in Chile.

As I understand it, we have had some success recently, getting commitments from the Chileans and from Argentina and also an anticipated contribution from Brazil that will bring us up to that 50 percent point; is that correct?

Dr. MASSEY. That is right.

Mr. STOKES. There still remain the requirements that the Appropriations Committees have set out, and let me just review those with you.

First, the last extension for putting the agreement together was to be May 15th of this year. By that time, we would expect that the Memoranda of Understanding will be signed between the United States and Canada, Great Britain, Chile, Argentina, and Brazil.

Secondly, the committee believes, in view of the fact that the United States is contributing 50 percent of the cost of these telescopes, $88 million, and that contribution was made without strings, in cash, that the other participants should be held to the same standards.

The committee has no objection if the funds are paid to a central account, that the management of the project may pay those monies back to participating countries in the form of work packages, et cetera. But every nation involved in this should contribute in cash to a central account similar to the procedure used under the ocean drilling program.

I guess what we would like to know from you is, if there are any misunderstandings about this position, are there any problems involved with it? And if there are problems, what are they?

Dr. Massey. Well, let me just say that there is no misunderstanding between the Foundation and the Congress as to what the ground rules are. And the ones you cited are certainly the ones that we have in mind, that we have to fulfill in order to come back to you.

Now, Bill, you may want to say more.

Dr. Harris. I think that is correct. We expect about April the 7th to have a meeting of the Finance Committee and go over all of these details and we hope to have that worked out by then, and we will keep staff fully informed of the progress.

Mr. Stokes. It is a possibility we can have this resolved by May 15th?

Dr. Harris. I am hoping by April 15th, certainly in advance of May 15th. Again, we will keep the staff fully informed.

GEMINI MIRROR SELECTION

Mr. Stokes. There has been a considerable dispute within the astronomy community concerning what type of mirrors that should be used for these two new eight-meter telescopes. Our committee stayed out of that controversy and we have no technical opinion one way or another.

Would you take a little time now to tell us what that dispute is all about and describe for us fairly the position of both sides and what your final recommendation is?

Dr. Massey. I will ask Dr. Harris to do that.

Dr. Harris. We are talking about new technologies to build these mirrors. We are building large mirrors and there are competing technologies that could be used to build these mirrors.

There was a general review of this process approximately a year ago and a review committee determined that they were at least viable competitors. There was an RFP proposed or sent out and there were two proposals, I believe, that were submitted. The major competing technologies are what is called a borosilicate mirror and the meniscus mirror.

Both technologies have risks associated with them because they have not built mirrors this large before. There are different risks, and different people come down on different sides of this issue. The Keck telescope that has now been constructed in Hawaii, and the second one being constructed, was also a risky situation. There they used small mirrors to build a 10-meter telescope, and my guess is that was probably controversial when it was built as well.

The RFP, the competition, led to the GEMINI program making a recommendation to go with the meniscus mirror that was produced by Corning. It was a much more cost-effective package. Both mirrors were judged to be close in technological capabilities, although the committee said, on the basis of just technology itself, the borosilicate mirror has fewer risks associated with it, but the meniscus mirror was a far better cost package.

It turned out, when that decision was made, the Europeans and Japanese had made a similar decision to go with the meniscus mirror. A contract was awarded to the Corning Corporation to go with this, and the dispute was about the technology.

THE HOUCK COMMITTEE

I am not an astronomer, and I won't claim to take sides either. But what we have done is, we had a committee set up (the Houck Committee) that looked at strictly that type of technology and came back and said there were risks associated with both mirrors.

They believe the risks associated with the borosilicate mirror were lower than the risks associated with the meniscus mirror. They said there was no "show-stopper" they could identify for the meniscus mirror, so there was no reason to overturn or reverse the contract decision for Corning.

So the Gemini international board has agreed with the process where they are going, I believe, starting this spring and finishing by next November, to look at the technology and engineering technology and design of both mirrors, with the assumption being, unless there is a show-stopper, that the meniscus mirror will be the mirror of choice.

There will be a full engineering design review of both mirrors within the next 9 months. It is an honest intellectual decision, and discussion and you are pushing technology in both areas.

Mr. STOKES. That is basically what we are going to get fair analysis of.

Dr. HARRIS. I am in the process of changing the U.S. representation on the Gemini board to ensure we have confidence in the process and that there is a clear focus on this whole thing.

Mr. MOLLOHAN. Mr. Chairman.

Mr. STOKES. Mr. Mollohan, sure.

COMPOSITION OF HOUCK COMMITTEE.

Mr. MOLLOHAN. Would you mind commenting on your thoughts about the make-up of the Houck Committee? To what extent did it broadly represented technology capability in the context of its ability to fully evaluate all the technology aspects associated with the two mirrors?

Dr. HARRIS. They are very good astronomers. Not being an astronomer or mirror expert, I would have to get back to you in some detail. My concern would be that when you talk about materials and the technology associated with that, they may not have had the full range of the debate you might have needed for that, but I wouldn't criticize this committee.

Mr. MOLLOHAN. I didn't ask you to criticize and I think they were excellent people. I am just asking you to comment on the composition the Committee from a multi-disciplinary perspective. Would you feel that its composition was so represented that it could analyze all the technical questions associated with the matter? You may not be able to answer the question.

Dr. HARRIS. It was not fully multi-disciplinary in the sense you are referring to, and I feel that the process that the Gemini international board has put together will do that kind of study. I have since talked to the Corning people about this as well to make sure I understand more of the material science needs, and basically the stabilization needs of this mirror.

So I also asked the person who is running the Gemini project, Sydney Wolf, to look into what the Europeans are doing with respect to technology and the actuators and so forth. So I think by the time they get their committee together, it will be a more comprehensive review, because you are making a decision on a go or no-go.

What I was trying to preserve was the option, so that if he found a show-stopper in the meniscus mirror for any reason in November, we would not have lost six months time. It will cost a little more money for this—$500,000—to have this package. I will get you more information and the committee if you want.

Mr. MOLLOHAN. Would you? Please elaborate on your answer to my specific question with regard to the composition.

Dr. HARRIS. Be glad to.

[The information follows:]

HOUCK COMMITTEE

The Houck Committee was formed in response to concerns expressed by Congressional staff and others about various aspects of the Gemini 8-Meter Telescopes Project at a meeting in November 1992. The committee was tasked with an independent technical review of the Gemini Project telescope design (charge to the committee attached). The members and their affiliations were:

Dr. Marc Davis, University of California; Dr. James Gunn, Princeton University; Dr. James Houck (Chair), Cornell University; Dr. John Huchra, Harvard-Smithsonian; Center for Astrophysics; Dr. Gerry Neugebauer, California Institute of Technology; Dr. Judith Pipher, University of Rochester; and Dr. Stephen Strom, University of Massachusetts.

All of the members are senior astronomers, well respected for their knowledge of astronomy, experience with astronomical instrumentation, activity in large and complex projects, etc. There was a clear emphasis on the infrared region of the spectrum since the Gemini telescope that will be built on Mauna Kea in Hawaii is to be infrared optimized. The membership reflects the charge to the committee, which emphasized the scientific requirements for the telescopes, performance specifications, and other systems level issues.

In the areas that generated the most committee discussion, the choice of the primary mirror technology, the ability of Corning to produce a meniscus blank to the required specifications was not questioned. No issues arose for which the presence of, for example, a materials scientist would have been helpful to the committee's deliberations.

Given the nature of the concerns expressed by the Houck Committee, one might argue that more engineering (structural and thermal) expertise should have been added to perform more detailed analysis of the relevant sub-systems. While this analysis is appropriate and necessary, it was far beyond the scope of the committee's charge and could not have been done in the time available. Such analyses will be carried out between now and the Preliminary Design Review, guided by the Houck Committee report. An appropriate interdisciplinary team will be involved.

Mr. STOKES. Finished?

Mr. MOLLOHAN. Yes I am, Mr. Chairman.

U.S. POLAR PROGRAMS RESTRUCTURING

Mr. STOKES. Turning to the U.S. Polar Programs Directorate, you are requesting $228,200,000 in 1994. How does that compare with the 1993 current plan?

Dr. MASSEY. I am going to ask Dr. Carol Roberts to answer that, but let me say, as you know, we have restructured the budget and it may seem somewhat complicated. But I will give you the parameters.

We created an Office of Polar Programs where before we had a division which was in the Geosciences Directorate and I sent you a letter explaining why we wanted to raise that to that level of avisability. But in the Office of Polar Programs, we placed some research efforts that were formerly in Geosciences but not in the Polar Programs Division, the Arctic Research Program, for example.

So now you will see the Polar Programs budget contains the old Antarctic research activity, some new Arctic research activities, and some support obligations. In addition, we kept the logistical appropriation. I think that is right.

Dr. Roberts. Yes.

ANTARCTIC AND ARCTIC RESEARCH

Mr. Stokes. Would you care to comment further?

Dr. Roberts. Mr. Chairman, the polar programs package will now consist of Arctic and Antarctic research activities in one program. The Arctic Research Program, compared with last year's revised current plan, is up 6.5 percent. We have a similar increase in Antarctic research. It also is up the same percentage.

Arctic research is, in 1994, $26.2 million and Antarctic, $28.5 million. And also in the same activity we have operations and science support for which we are asking $108.4 million.

The Antarctic logistical support line would be unchanged from last year, $59.1 million, with SEH being $6 million.

Mr. Stokes. Can you give me your 1993 number under your current plan?

Dr. Roberts. The FY 1993 numbers are for Arctic research, $24.6 million, and that includes the $2.5 million increment.

POLAR PROGRAMS BUDGET

Mr. Stokes. I guess what we want is the entire program, U.S. Polar Programs Directorate, for your whole program.

Dr. Roberts. $245.96 million in 1993.

Mr. Stokes. Okay.

Dr. Roberts. And $228.22 million in 1994.

Mr. Stokes. Dr. Massey, you have mentioned change in the budget structure. And it is very difficult for us to be able to follow on, say, an apples-to-apples basis. Tell us how much you are proposing in 1994 for the Antarctic program versus the current 1993 plan, that is the total Antarctic program.

Dr. Massey. That would be everything except the Arctic Research Program. I thought we put a page in there on that.

Mr. Stokes. If you would rather get it for the record.

Dr. Massey. I will get it to you because I don't see where we added it all up as a total. We put it in research, science support, and logistics. So we can consolidate that.

Mr. Stokes. That would be fine.

[The information follows:]

U.S. ANTARCTIC PROGRAM BUDGET—FUNDING FOR THE U.S. ANTARCTIC PROGRAM

(Millions of dollars)

Fiscal year—	Subactivity				Change	
	1992 actual	1993 request	1993 current plan	1994 request	Amount	Pcnt
U.S. Antarctic research program	22.00	26.74	26.74	28.48	1.74	6.5
Operations and science support	75.37	77.16	72.16	108.42	36.26	50.2
U.S. Antarctic logistical support	65.00	59.10	59.10	59.10	0.00	0.0
SEH	30.00	14.00	14.00	6.00	−8.00	−57.1
Aircraft procurement			49.36		−49.36	−100.0
Total, activity	192.37	177.00	221.36	202.00	−19.36	−8.7

LC–130 AIRCRAFT

Mr. STOKES. Now, is the difference primarily the one time appropriation for a new LC–130 ski-equipped aircraft for that $49,360,000?

Dr. MASSEY. Yes.

Mr. STOKES. Has the order for the aircraft been put in place?

Dr. ROBERTS. Sir, we are working with NAVAIR. The order will be placed through DOD and we are working with those folks right now on that.

Mr. STOKES. Can you tell us when?

Dr. ROBERTS. There will be a peconfiguration meeting at NAVAIR in May, and in early summer the configuration meeting will take place in Marietta, Georgia, with the Lockheed people.

DOD SUPPORT OF ANTARTIC PROGRAM

Mr. STOKES. We understand that the Navy is seeking to substantially reduce its involvement in the Antarctic Program. What functions are they seeking to turn over to the Foundation, and how well is the agency willing to accept these responsibilities?

Dr. MASSEY. That is a very complicated issue, as you might imagine, Mr. Chairman. The Navy, of course, now supports all the logistics and some of these engineering activities. And they have indicated they would like to withdraw from even supporting the logistics on a reimbursable basis.

We are now engaged in discussions with the Department of Defense as well as the White House because we think such a change would pose serious problems for the operation of the Antarctic Program, and it would make it very difficult for us to carry out our obligation. But I would ask Dr. Bernthal, to whom this program reports, to say a little bit more.

Dr. BERNTHAL. Well, first of all, Mr. Chairman, I would point out that our Board has been very concerned about this issue as well. In its last meeting, it passed a resolution supporting the continued involvement in logistics support of DOD and, of course, the Navy in our Antarctic operations, in effect, going on record in support of the existing executive order that dates back to 1982 which directs the Department of Defense to provide those logistical support activities.

As Dr. Massey has indicated, in the current climate there is a continuing desire and intent on the part of the Navy especially, generally on the part of the Department of Defense, to disengage from any activity that they don't see as being one of great strategic importance.

We believe and we hope that, ultimately, the administration and Department of Defense will believe that a continued and active presence of the Department of Defense, either through Navy, through Air Force as well, perhaps, is in the national interest. So what I have outlined for you is really the policy position that the NSF and the Board is now operating with.

IMPACT OF NATIONAL ENVIRONMENTAL POLICY ACT

Mr. Stokes. Thank you.

We also understand that the Justice Department has declined to appeal a recent circuit court decision that held that the National Environmental Policy Act applies to U.S. activity in the Antarctic. What effect will this have on the operations and research activities of the program?

Dr. Massey. I will ask Dr. Bernthal to respond.

Dr. Bernthal. I will respond very briefly, Mr. Chairman, and then I will ask our General Counsel to respond very briefly on the status of that litigation.

The very short answer to your question is that the issue of the application of NEPA to our operations in the Antarctic we now view as being settled because the court ruled that NEPA applies to our operations. The Administration has taken a position that they will not appeal that decision, so we are going to learn the application of NEPA to our research activities in the Antarctic. We hope and believe that will not cause any undue schedule difficulties in our scientific research operations.

Let me ask Larry Rudolph, our General Counsel, to comment very briefly on the status.

Mr. Rudolph. Mr. Chairman.

Mr. Stokes. Mr. Rudolph.

Mr. Rudolph. We, of course, accept the administration's position not to petition for a rehearing of this case. And, Dr. Bernthal said, we will make certain that we conduct our environmental assessments consistent with the NEPA applying. We are still, however, in the process of litigating that case in the lower court below as to whether or not we properly assessed the incinerator according to NEPA standards. We maintain what we have and that remains to be litigated yet. We are proceeding in compliance with the laws as we understand them.

COSTS OF COMPLIANCE WITH REGULATIONS

Mr. Stokes. I guess a concern is whether any additional costs will be incurred as a result of that decision.

Dr. Bernthal. The answer is yes, although I would say these would be marginal costs, because we, in effect, were complying with the requirements in the spirit of NEPA. In fact, the recent Madrid protocol on the Antarctic environment to which we are now a party required us, in effect, to comply with the very similar standard that would fall under NEPA. So there would be some extra expenses to us because we will now have requirements for cooperation with other agencies, perhaps, certainly some additional paperwork.

I am not sure we can put a dollar number on that, but let me ask Dr. Roberts to comment.

Mr. Stokes. Dr. Roberts.

Dr. Roberts. Sir, we estimate that the annual cost for retrograding of generated waste will be about $4 million, and the annual cost of compliance with the new regulations will probably be another $4.5 million. So we are looking at possibly an $8.5 million annual cost.

Mr. Stokes. As a result of——

Dr. Roberts [continuing]. Waste handling, including the implementation of these regulations, will cost about $8.5 million.

Mr. Stokes. I see.

Dr. Bernthal. The point I wanted to make is we would be doing that substantially in any case whether or not this court decision would apply.

SOCIAL, BEHAVIORAL, AND ECONOMIC SCIENCES

Mr. Stokes. The request for behavioral and economic sciences in 1994 is $106,910,000. That compares to $89,530,000 under the current plan; is that correct?

Dr. Massey. Yes.

Mr. Stokes. I want to ask the Assistant Director what the NSF 1994 request to OMB was.

Dr. Marrett. The total request to OMB for 1994?

Mr. Stokes. Yes, ma'am.

Dr. Marrett. Including the supplemental, what you have is our request, $106 million.

Mr. Stokes. What did you ask OMB for, your request to them?

Dr. Marrett. Our request to OMB for FY 1994 was $131 million.

Mr. Stokes. It was?

Dr. Marrett. Yes.

Mr. Stokes. All right. Are you satisfied this directorate is getting a fair share from the NSF when the Foundation allocates the $3 billion request?

Dr. Marrett. Yes. We are quite pleased.

I think the question would be about the overall budget for the entire Foundation. As is true of the other fields, a larger request would allow us to do a number of things, better enabling the research, and carrying out the initiatives. But there is no sense of unfairness in terms of the distribution across the several fields.

Mr. Stokes. Thank you.

URBAN SYSTEMIC INITIATIVE

Now, NSF requests $556.1 million for education and human resource activities in fiscal year 1994, a 14.1 percent increase over last year's level of $487.5 million.

NSF requests a total of $19 million for the Urban Systemic Initiative, a program designed to promote better math, science, and engineering education for large urban school districts. This is $14 million more than the fiscal year 1993 appropriation of $5 million for start-up costs. Are these figures correct?

Dr. WILLIAMS. Yes.

Mr. STOKES. This is a departure for the NSF, which traditionally has worked at the State level, rather than with local school boards. I commented earlier on Dr. Powell's statement last year to the effect that many school boards allow students to abandon math and science education too early, before they can really understand their own abilities. And might the Urban Systemic Initiative provide an opportunity to focus on these and other issues that are usually handled at the local level?

Dr. Williams?

Dr. WILLIAMS. Indeed, as you stated, this is a major departure for the Foundation. In our view, it probably is the best mechanism to comprehensively address quality instruction of math and science education for youngsters in large urban areas, and the Foundation has the advantage of drawing on the experience we have gained over the past two years of running the State systemic initiative. But its goals are precisely what you stated.

EPSCOR

Mr. STOKES. There is a systemic reform initiative that is not part of the requested increase, the Experimental Program to Stimulate Competitive Research, EPSCoR, which seeks to help research-poor States compete for research contracts. NSF spent $18 million for EPSCoR in fiscal year 1992, $24 million in 1993, and intends to spend another $24 million in fiscal year 1994.

In December of 1992, the President's Council of Advisors on Science and Technology released a report entitled: "Renewing the Promise: Research-Intensive Universities and the Nation". This report urged Federal agencies to refrain from developing programs that would increase the net capacity of the Nation's research-intensive universities, asserting that spreading our resources too thinly will inevitably destroy the most important aspect of American higher education and research quality.

Do you agree? And, if not, tell us why.

Dr. MASSEY. The way I interpreted that was that we should make sure that we, before we make long commitments as a Federal agency, that we have the capacity to, in fact, follow through on those commitments.

I didn't interpret it as saying we have enough science and technology excellence in the country—I wouldn't apply that statement to an EPSCoR-type program. I thought they were asking states to look at whether they should be consolidating activities within states rather than whether states as a whole should be brought up to levels of excellence.

Mr. STOKES. You are saying have this apply on an EPSCoR funding levels?

Dr. MASSEY. No, I do not. As I said, I think the spirit is asking each of the states, do you have too many branches of institutions? Should you look at consolidation? Not whether we as a Nation ought to try to bring every state up to a level of compliance.

Mr. Stokes. Dr. Massey, the Appropriations Committee Conference Report of September 24th, 1992, directed the Foundation to withhold $5 million from EPSCoR until it produces a plan to integrate similar programs from other agencies into a unified Federal effort. The report, received on February 10th, 1993, notes that the NSF established an interagency committee to provide a forum for cooperation.

The report states the committee will draft a memorandum of understanding outlining the terms of interagency cooperation. The record asserts that the MOU will be ready for signature early in 1993. Has it been signed?

Dr. Massey. I don't think it has been signed.

Dr. Williams. It has not been signed, but it has been drafted by the committee, forwarded to all of the agencies, and we expect to sign it on the meeting of this committee on May 8th.

STATE ELIGIBILITY FOR EPSCOR

Mr. Stokes. The State eligibility for EPSCoR funding varies from agency to agency. What will be done to create uniform eligibility requirements?

Dr. Williams. We are going to do two things. There is a science and technology committee in each State. We have asked them to give recommendations to this interagency committee in terms of normalizing the eligibility requirements for the different agencies.

And, second, I chair that interagency committee, and I created a task force that has given them the responsibility for taking each agency's estimate and trying to normalize them, at least where possible, to some generic components. And we are making some progress.

Mr. Stokes. Dr. Williams, has the interagency group reached agreement on key topics such as non-Federal matching fund requirements and how to assess EPSCoR outcomes?

Dr. Williams. We have reached an agreement on the assessment of the EPSCoR outcome. It will be done by NSF acting on behalf of all the agencies.

We haven't reached agreement yet on matching, but it is under discussion, and I am reasonably confident that we will accomplish the majority of it. There are some aspects that are agency specific that I suspect we can't fully negotiate.

Mr. Stokes. When do you expect the implementation plan for EPSCoR coordination to be complete?

Dr. Williams. This summer. Spring, summer.

Mr. Stokes. Mr. Mollohan.

Mr. Mollohan. Thank you, Mr. Chairman.

Mr. Stokes. Sure.

EPSCOR REQUEST FOR FY 1994

Mr. Mollohan. Do I understand that you are requesting $24 million in fiscal year 1994 for EPSCoR?

Dr. Massey. Yes.

Mr. Mollohan. Which is the same amount you requested in 1993?

Dr. Massey. Yes.

Mr. STOKES. For 1993?

Dr. WILLIAMS. No, it is not. We—as you recall, our request was $5 million less, and there was Congressional increment.

Dr. MASSEY. The request—I am sorry.

Dr. WILLIAMS. We are requesting the same amount.

Mr. MOLLOHAN. You are at a greater level of detail than I am.

Dr. MASSEY. It is the same amount of money.

Mr. MOLLOHAN. So your request in 1993 was $5 million less?

Dr. MASSEY. Than what we received.

Mr. MOLLOHAN. You were appropriated $24 million.

Dr. MASSEY. That is right.

Mr. MOLLOHAN. So your request for this year is $24 million also?

Dr. MASSEY. That is correct.

Mr. MOLLOHAN. What will be your anticipated expenditure? Will you spend all of that $24 million in 1993 on EPSCoR programs?

Dr. WILLIAMS. We expect to, yes. As you know, we currently have funding for 18 States, plus Puerto Rico. We have two States that are nearing an award, probably within a month. We have four States that are involved in competition proposals before us. So we expect to spend the total amount.

Mr. MOLLOHAN. So 24 really does assume—or let me ask you, does that assume that no other State is going to achieve EPSCoR's eligibility programs in 1994?

Dr. WILLIAMS. Yes, it is.

Mr. MOLLOHAN. It assumes that they will not?

Dr. WILLIAMS. Well, we don't have any reason to expect the number of States that are eligible for the program to increase.

Mr. MOLLOHAN. Why?

Dr. WILLIAMS. Because we are not actively involved in discussions.

Mr. MOLLOHAN. I am sorry. It might be my ears, but I can't hear you.

Mr. STOKES. The reporter is having difficulty hearing you, too, Dr. Williams.

Dr. WILLIAMS. The question, do I expect the number of States eligible for the program to increase. The number of States eligible are 18 States plus Puerto Rico. My answer was, no, we are not involved in any discussion with a State that might become eligible, so, no, I don't expect it.

Mr. MOLLOHAN. I think that is enough. Thank you very much.

Mr. STOKES. Mr. Mollohan, I yield to you.

Mr. MOLLOHAN. Thank you, Mr. Chairman.

GLOBAL CHANGE RESEARCH PROGRAM

Doctor, I would like to go back to the Global Research Change Program, to your geosciences activity, if I might.

In your fiscal 1994 request for geoscience, you have indicated that 70 percent of geosciences comes from NSF.

Dr. MASSEY. Seventy. Is that right?

Dr. CORELL. Around 70 percent in academic institutions in these disciplines from NSF.

Dr. MASSEY. Not all of it.

Mr. MOLLOHAN. I think that is making a great contribution to the other activities that are going on. And we need that capability to use all of that information when it comes down. So I am very supportive of that.

And it strikes me that the system can only be as effective as the researchers are skilled to analyze all of this data that is going to come down.

So really, what I am asking you to—giving you an opportunity to elaborate on, this line item is really the linchpin for our success in global research change. And really I would just like your comment, for the record, on that.

Dr. MASSEY. I think that is true. I think the programs in research that the NSF primarily funds are the underpinning for much of the other understandings of what is happening in global change.

And also, for the development of technologies, that is needed to understand it.

Mr. MOLLOHAN. And the capability of the people?

Dr. MASSEY. And the production of research and people themselves.

Mr. MOLLOHAN. How is it going?

Dr. CORELL. The Global Change Program, as you know, has been under way for five years and has been growing both in terms of its productivity; and we will have, next week, for release, a booklet that will describe all of the FCCSET initiatives and then in the early part of the summer, there will be a comprehensive budget book. Historically, we release it at the time of the release of the budget; but because of the change of the administration and so on, it turns out it is prudent to do it at two times this year. But in that, you will find a section on the productivity of the program.

And from the prospective of the reviews that we have had from the academies and so on, the program is going on nicely. There is a growing basis of support. There are problems that are also inevitable with a program this size in scope involving 11 agencies.

ALLIANCES FOR MINORITY PARTICIPATION

Mr. STOKES. NSF requested a total of 19.8 million for the Alliances for Minority Participation. AMP has been designed to increase the number of minority students graduating with bachelors in science, engineering, and math from about 12,000 per year in 1990 to 50,000 in the year 2000.

NSF spent $10 million for 11 AMP awards in fiscal year 1992 and $12.8 million for 15 awards in fiscal year 1993 and proposes spending $19.8 million for 20 awards in fiscal year 1994.

Are these figures correct?

Dr. MASSEY. Yes.

Mr. STOKES. Your justification materials state that, "Each AMP project will at least double the current production of baccalaureate degrees awarded to minority and under-represented individuals within five years."

Do you expect to achieve the original goal of 50,000 by the year 2,000?

Dr. MASSEY. We do. And we won't go into detail, but at some point, I would like Dr. Williams to brief you in a written report. He has had a recent review that shows-he might want to say something more.

Dr. WILLIAMS. This is after two years. The enrollment achievement of most of the 11 centers was several times higher than what we expected. And the most remarkable development after two years of operation of what is otherwise a four- or five-year program, students have actually graduated. The number of graduates right now should be zero.

So it is a very aggressive report in terms of the progress that has been made.

And I agree with Dr. Massey.

Mr. STOKES. I would be glad to also have that briefing, Dr. Williams.

Dr. WILLIAMS. Yes, sir.

Mr. STOKES. To have remained roughly on target in reaching the 50,000 goal, a total of 20,000 minorities should be receiving degrees in science, engineering, and math, SEM fields, in 1993.

How many minorities will receive degrees in the SEM field this year?

Dr. WILLIAMS. About 16,000, 16,800 this year.

Mr. STOKES. If you succeed in increasing the number of SEM graduates, how will you ensure that they will obtain jobs in their major or related fields?

I thought I would give you an easy one.

Dr. WILLIAMS. Yes, sir. Clearly we are attracting-it's very comprehensive. One of the goals is to go into the graduate schools and be competitive and have these students assume their place in the scientific and engineering enterprise.

Second, while we are making extraordinary efforts, one very important part of this is they are going to have advantages in terms of faculty assisting in terms of employment opportunity. So I don't expect that to be a problem.

Mr. STOKES. But you do have a tracking process that is under way in conjunction with that?

Dr. WILLIAMS. Yes, sir.

MODEL INSTITUTIONS FOR EXCELLENCE

Mr. STOKES. That is important.

The NSF requests a total of $2.5 million for a new program called "Model Institutions for Excellence" intended to provide resources for minority institutions to increase retention and graduation in science, math, and engineering. This program was not funded in fiscal year 1993.

Tell us, how does this interact with the AMP program?

Dr. WILLIAMS. This program will be a Foundation-wide effort initiated at the urging of the Director, and involves the entire Foundation.

It is consistent with what you have stipulated by the executive order with respect to HBCU and minority students in general. But the goal of this program is to contribute to the AMP goals by making major awards to a select number of minority institutions characterized by being very productive in their outcome of science, engineering, and mathematic graduates.

So it would be a major mechanism to augment achieving our goals, but also something that is more important than that and that is to report on the cadre of minority institutions' long-term capabilities.

Mr. STOKES. Tell us, Dr. Williams, how much will this program cost in fiscal year 1995?

Dr. WILLIAMS. The goal is to make—1995?

Mr. STOKES. Yes, sir, fiscal year 1995.

Dr. WILLIAMS. It will be the fiscal 1994 base plus the decision we have not made. I don't know at this point.

Mr. STOKES. Do you have a five-year funding plan?

Dr. WILLIAMS. Yes.

Mr. STOKES. Okay. I am reminded thaτ if you have a five-year plan, you must have a 1995 figure.

Dr. WILLIAMS. Well, the goal that it was to start-we thought initially in 1994 with perhaps three awards, but now we are even talking about starting six. It is an evolving process.

The 1995 number will really depend on what we actually do in 1994. But what we hope to do is establish across HBCUs, plus institutions that serve a significant number of Hispanic students and a small number of Native American institutions, probably 10 to 12 such centers. But that is over a five-year period.

Dr. STOKES. Explain that for us in the record and tell us how this program relates to the goals and objectives of the executive order on historically black colleges and universities.

MODEL INSTITUTIONS FOR EXCELLENCE

In FY 1993, the Model Institutions for Excellence (MIE) initiative will support up to 15 planning grants to enable institutions to develop full implementation plans, and proposals. Total funding is anticipated to be $1 million.

We anticipate making at least three awards in FY 1994 for $8.5 million, and possibly as many as six, depending upon the availability of funds. The 1995 number will depend on what we actually do in 1994. Our current plans are that the maximum amount of funding would be about $15 million in the out years.

The program will increase the Foundation's commitment to meeting the requirements of Executive Order 12677 on historically black colleges and universities (HBCUs), since two major goals of the program are to increase the number of minority students graduating from minority institutions with balchelor's degrees in SEM and to increase the number entering graduate school.

Dr. WILLIAMS. Yes, sir.

NSF/NIH CO-FUNDING EDUCATION PROGRAMS

Mr. STOKES. Now, I understand that NSF and NIH are co-funding precollege and undergraduate education programs for minorities; is that correct?

Dr. WILLIAMS. Yes.

Mr. STOKES. And how much did the NSF spend on this cooperative effort in fiscal years 1992 and 1993?

And tell us how much is planned to be spent in fiscal year 1994?

Dr. WILLIAMS. Okay. Our expenditures were $19 million last fiscal year. It will be roughly the same this fiscal year. Our plans for next year—the total budget will increase by $7 million, which is requested for the AMPs program. So it would be $26 million, all the precollege plus the undergraduate programs together.

NIH joined us, as we mentioned, last year, in 1992, and contributed $1.8 million. We had a meeting with them just yesterday afternoon, and they will spend that amount in fiscal year 1993.

And we have made a long-term commitment where we will continue to collaborate, basically, for four or five years. This is as a result of Dr. Massey and Dr. Healy of NIH, and it is a major achievement in my view.

Mr. STOKES. I agree with you. And I was very much aware when you established this program that we were glad that we could participate at that time.

Let me ask you: Do you have any plans to try to expand this to any of the other agencies?

Dr. WILLIAMS. I think there is overwhelming logic that says that is what we should do. There is an analogue in the way that we were talking about the EPSCoR program.

Many agencies have a small program, but they are not unified around a major goal. But what we think would be very desirable is for a variety of agencies to come together around a common program plan. And we collaborate in support of it, as opposed to supporting separate ventures.

UNDERGRADUATE EDUCATION

Mr. LEWIS. Mr. Chairman?

Mr. STOKES. Mr. Lewis.

Mr. LEWIS. The December 1994 report done by the Federal Coordinating Council for Science Engineering and Technology, which Dr. Massey chaired, identified a concern over the effect that research grants have on quality of undergraduate education. Specifically, the line is that good students follow where the money flows.

I would like to know how serious you think this problem is and what, if anything, we can do to correct it?

Dr. MASSEY. Well our concern, also, in that report was to make sure that Federal agencies funding research at universities were conscious and held universities also accountable for making sure that those funds did not lead to lack of attention to undergraduate education and that, in fact, the research funds are to contribute to university efforts to improve undergraduate education.

Mr. LEWIS. Implicit in that was, though, that good students would flow in the direction of the grant money in specific fields of scientific endeavors, implying that disciplines can be affected by where the money may be. Is that a problem?

Dr. MASSEY. No, that was not the concern. That is an observation. The concern was the opposite, that the research agenda might become such a high priority that the scientists and the institutions would neglect the undergraduates.

Mr. LEWIS. Your request for the undergraduate education subactivity makes note of a 1.2 percent increase for programs to inspire undergraduates to learn science.

There is a suggestion contained in the budget justifications for curriculum and laboratory development that support will encourage changes in the faculty culture leading to increased involvement of active science educational development.

I have twin sons who are in academia: What is it about the faculty culture that causes professional educators to lose focus upon educational development in math and science?

Dr. MASSEY. Well, there are a variety. It is not uniform. Of course.

There are places in which the integration of research and education is excellent. But the feeling of many of us that have been in academia for a while is that we should put more attention on the undergraduate curriculum than we have in the past. I am not sure of all the causes.

Some would say that there have not been enough incentives for agencies such as ours to make sure that researchers are actively involved in the undergraduate education. And this program is to build more incentives into that process.

SCIENTIFIC AND ADVANCED TECHNOLOGY ACT

Mr. LEWIS. If I could, Mr. Chairman, one more question.

Last year the House Space and Science Committee, acting on a 1989 NSF report, enacted the Scientific and Advanced Technology Act. This authorization anticipated funding on the order of $35 million a year to establish Centers of Excellence and to provide grants for America's two-year colleges to increase technical literacy for our work force.

When the bill was before our Congress last year, you wrote a letter to Chairman Brown in which you stated:

> Our Organic Act already provides us the necessary objective to carry out the goals of H.S. 2936 and this bill adds nothing new to NSF's authority in this area; and, therefore, the administration opposes the bill.

I have been reading your words and appreciating the care and precision with which they seem to have been drafted. Yet your budget is $4.5 million to an existing base of $3 million for science and math education at the community college and college level. $7.5 million amounts to less than 1 percent of the Education and Human Resources Activity of $556 million.

Can we really expect much for $7.5 million when it is split competitively between 1,350 two-year colleges?

Dr. MASSEY. I will let Dr. Williams say a little bit more about it. But as I understand, this is an area that we are entering fairly recently. That is, focusing on the community colleges.

So I think you will see the growth is significant. But it is a small percentage of our budget. And we are feeling our way how to best integrate those colleges into our program. So that is the answer.

In terms of my answer to Congressman Brown, I was simply saying that we didn't need any different, additional authority to do this.

Dr. WILLIAMS. That is the situation; the issue of authority. What is needed in the two-year college, what the bill calls for and we propose to do, is essentially programs that we have.

The major problem is to improve the faculty in these institutions. We mean to have faculty development, to increase the laboratories, improve the laboratories. We have an Instrumentation and Laboratories Improvement program.

And the third is to deal with lower level courses that made it possible for two-year college graduates to matriculate to the four-year colleges. Those are our three principal undergraduate programs.

Thus the statement that we didn't need additional authority, to comment on the budget, is exactly as Dr. Massey indicated. This is without apology. It is a fact, at least two or three years ago, the Foundation gave little attention to this.

We have increased that from less than a million to $3 million to $7 million and now better than $12 million in the FY 94 Request. What we will do with the new money, if appropriated, is to focus them around instrumentation, faculty, and course and curriculum development in strategic parts of the country—the centers that are called for in the bill.

I assure you that, while the amount is small, certainly our interest in and acknowledgment of the significance of this program is enormous. And it is one that is going to grow because it is crucial.

Mr. LEWIS. My interest in this stems from the success of one community college in Southern California that has a long-established relationship where young people who happen to be interested in the field of dentistry, in a sizable percentage, go from a two-year level directly into the USC Dental School.

And the more we can help to develop the potential of those two-year colleges the more worthwhile is the investment.

Dr. MASSEY. I agree.

SUPPORT FOR WOMEN AND GIRLS IN SCIENCE

Mr. STOKES. NSF requests a total of $7 million in fiscal year 1994 for Women and Girls in Science, a program aimed at all educational levels to encourage and support women interested in scientific careers.

NSF spent $1.3 million on this project in fiscal year 1992, $2 million in fiscal year 1993. This request represents a more than tripling of the effort.

How many women and girls did you reach in fiscal year 1992 and 1993?

And tell us how many you expect to reach in fiscal year 1994.

Dr. WILLIAMS. Mr. Chairman, we will have to provide that for the record. I don't know the answer. But I will make one comment about the significant increase. This represents an effort to seriously engage the issue. That is why it is so significant. Whatever the numbers turn out to be in terms of the delta, the change is going to be substantial, relative to what we have done.

Mr. STOKES. Also, Dr. Williams, provide in the record: Of the individuals that you have contacted, how many have you interested in science?

[The information follows:]

WOMEN'S PROGRAM

FY 1992 projects involved slightly over 2,000 participants. While we expect this number to grow in FY 1993 (proposals are not yet in) and 1994, the impact upon larger numbers of participants will probably be more visible in FY 1995 when some infrastructure is in place.

Data are not available on how many women have become interested in science as a result of our projects. Our purpose is to provide information about careers in science, mathematics and engineering to girls and young women so that they are aware of the options open to them. As a result, these young women can position themselves appropriately so that they do not forgo opportunities because of inadequate preparation. In addition, important targets for this information are parents, teachers, counselors and other educational personnel. Impact measures will be addressed as an evaluation plan is developed for this activity.

SUPPORT FOR PERSONS WITH DISABILITIES

Mr. STOKES. NSF requests a total of $3.6 million to increase the involvement of persons with disabilities in science. This program received $600,000 dollars in fiscal year 1992 and $1.1 million in fiscal year 1993. Will these expenditures be used primarily to interest persons with disabilities in science, or to provide assistance to persons already interested in scientific pursuits to reach their goals?

Dr. WILLIAMS. It will do both. But initially what it will do is address the needs of the students that are already in the pipeline for which the Foundation, as you indicated, at the level of $600,000 wasn't really making that much of a contribution. Over time, the program will change focus, shift around and entice an increased number of disabled youngsters into science. But right now the initial focus is on getting equipment, to make more reasonable provision for youngsters already in the system.

PARENTAL INVOLVEMENT IN SCIENCE EDUCATION

Mr. LEWIS. Will you yield?

Mr. STOKES. Certainly.

Mr. LEWIS. For some time I have been interested in the raging debate about parental involvement in education. I have been specifically interested in this city, D.C., and what might happen if we were more effective in tapping parent involvement that specifically relates to the field of science. If you get parents involved with the schools, looking at books in some cases and teacher training, would we gain a better understanding of the role that math and science has on these young people in the long-term . That is important. What is NSF doing in that relation?

Dr. WILLIAMS. We can pull together various activities from various supports. We are doing it a lot. I think parental involvement is crucial. It is in a variety of programs we are supporting.

DISTRICT OF COLUMBIA: EXPERIMENTAL MODEL CITY

Mr. LEWIS. I have not talked with my chairman about this yet. I intend to, rather sensitively, at some other time.

But it does seem to me that there is a potential. If there is a city in the country which is an inner city where there is potential for important and very productive experimentation for model, it is this city. You are smiling.

Dr. WILLIAMS. I am smiling because I agree with you and we have under way a comprehensive plan for the District of Columbia for all of the reasons that you cited. It is one of the reasons that the District of Columbia is not among the 25 other cities eligible for support, because we see it as comparatively unique, really, in terms of all the resources that could be brought to bear in a very experimental way.

Mr. LEWIS. It is a city that we have a very special responsibility for. I would like to know more about that.

Dr. WILLIAMS. We will share with you on that.

Mr. STOKES. Good suggestion, Jerry. I can see why Dr. Williams is so receptive to it. The District of Columbia is obviously a model city to meet all the criteria that you would want to set up a test pilot program.

Mr. LEWIS. It is a potential model that justifies some new approaches in my judgment, Mr. Chairman.

TOTAL SUPPORT FOR PERSONS WITH DISABILITIES

Mr. STOKES. Right. How much does NSF spend in total to aid people with disabilities? Any figures on that? If not, you can provide it for the record.

Dr. WILLIAMS. It is $1.1 million.

Mr. STOKES. $1.1 million. Okay.

COURSE AND CURRICULUM DEVELOPMENT

NSF requests $4.5 million above the fiscal year 1993 appropriation to develop new curricula for first year math and science courses in four-year colleges. How much did NSF spend in fiscal years 1992, 1993, for this purpose?

Dr. WILLIAMS. I will provide it for the record.

Mr. STOKES. For the record?

Dr. WILLIAMS. Yes.

Mr. STOKES. All right. Tell us also how much you plan to spend for this activity in total for fiscal year 1994.

In testimony last year, Dr. Williams, you noted that introductory chemistry, physics and math courses often act as student filters and fail to interest students in the subject matter. How can NSF overcome the attitudes of faculty who have supported the current system for years?

Dr. WILLIAMS. Primarily, we are doing two things in our course and curriculum development as far as reviving the courses making them more experiential. The effort was a capital project. Our best example is our effort in calculus, which has occasioned nationwide nothing short of reform. It is probably the ultimate data.

What we have done is move from the blackboard, chalk-and-board approach in teaching calculus to teaching it in a very hands-on way where the students are involved. It is being replicated in a lot of institutions. We are moving to do the same thing in chemistry and physics.

And a part of the request is for the courses of development; to do it not in individual institutions even though we make individual grants. The goal is to have to render the process more efficacious for students throughout the country, not where we coincidentally happen to make the award.

Mr. STOKES. How do you respond to those who might argue that revisions to the current curricula may reduce the quality in math/science education?

Dr. **Williams**. Everything I am aware of says quite the opposite. That is my response.

Mr. **Lewis**. That covers it.

FUNDING OF COURSE AND CURRICULUM DEVELOPMENT

Mr. **Stokes**. That takes care of that.

NSF spends money on curriculum development in all aspects of its education activities from kindergarten to undergraduate courses.

What is NSF's total spending on curriculum development at all levels, K through 16? In all areas?

Dr. **Williams**. I will provide it.

[The information follows:]

Curriculum Development

The funding for curriculum development at the K–12 level and at the undergraduate (13–16) level follows:

	Fiscal year—		
	1992	1993	1994
K–12	$41.0	$39.7	$45.5
Undergraduate	17.8	17.8	25.4
Total	58.8	57.5	70.9

Mr. **Stokes**. Is this money generally used to support textbook and software writing, or to create course syllabi?

Dr. **Williams**. Course syllabi, not textbook writing, there is some technology, and software, but it is primarily course instruction materials. Not very much technology.

Mr. **Stokes**. Tell us why so much money is needed in this area given the lively private market in textbook publishing.

Dr. **Williams**. Well, the role of the publishing industry is to take the products developed with NSF support and massively produce those and sell them to the students and the school system. Our task is to make grants to mathematicians and scientists whose task it is to go through the content and the pedagogy and provide for the publishing industry a model for what should be done.

The example that I gave in respect to calculus—what has happened with that project is colleges and universities are interested in it, and three or four publishing companies are actually producing the product.

Mr. **Lewis**. As the Chairman goes forward with some of these questions, could someone dig out the answer to that question on K through 12? How much do you spend on curriculum K through 12?

Is that all right, Mr. Chairman?

TECHNICAL TRAINING FOR SECONDARY SCHOOLS

Mr. **Stokes**. Sure. NSF requests an additional $1.5 million for technical training for secondary school students. How much did NSF spend in fiscal years 1992 and 1993 on this program?

Dr. **Williams**. Nothing. This is a new one. This is to make sure that students starting at the 10th grade get the appropriate math and science courses in order to go on to technical education. This is the high school component to support the technical education bill that I was just speaking to Mr. Lewis about.

Mr. Stokes. Often technical courses in high school become a mechanism for tracking poor students. In response to Congressman McDade during testimony last year, NSF commented for the record that one of the major causes of poor math and science education is extensive use of tracking.

Might encouraging specialized technical courses exacerbate this problem?

Dr. Williams. I don't think so. What we are discovering in the State-wide Systemic Initiative program, we are discovering in some of the other K-to-12 programs where there is a substantial number of minority and disadvantaged students, the fundamental issue is one of policy. If we insist that substantial programs supported by NSF not have tracking, school systems set high standards with those systems and get very good outcomes. So, it is precisely the opposite.

SUMMER SCIENCE CAMPS

Mr. Stokes. Let me ask you about a program, as you know, I have a special interest in; and that is last fiscal year NSF received better than 100 proposals for the Minority Summer Science Camps Program. How much money did you obligate in fiscal year 1992 and how many awards did you make?

Dr. Williams. We spent the $2 million and we made 28 awards.

Mr. Stokes. Tell us what do you expect to spend come fiscal year 1993 and 1994, and how many awards do you expect to issue?

Dr. Williams. We hope a comparable amount. Our plans are about $2 million. The application demand has continued as it has in the first year, so we will have an opportunity to make about 25 to 30 really excellent awards per year in FY 1993, 1994.

MATH/SCIENCE PROGRAMS EVALUATION

Mr. Stokes. NSF requests an additional $3 million for evaluations for a total of $9 million. Are all grants evaluated?

Dr. Williams. The reason NSF's budget for evaluation has increased significantly is that we, as you know, were directed by the Congress to evaluate all math/science programs through all the FCCSET agencies. So we have that responsibility. And in the report to Congress I provided—we provided an evaluation plan not only for NSF's programs but for all the other 11 agencies. That is under way.

The programs of NSF and others are being evaluated this year and that will continue over a five-year program. We continue to evaluate programs that are under the FCCSET umbrella.

Mr. Stokes. Do all projects receive mid-term as well as end-of-project evaluations?

Dr. Williams. Yes, sir.

Mr. Stokes. The committee looks forward to reading the NSF evaluation of math/science education programs due in May of 1993. What other evaluations are you planning?

Dr. **Williams**. We will provide that and we have evaluations underway in many of the K-to-12 programs dealing with teacher preparation, teacher enhancement, which is the largest operation. The Instrumentation and Laboratory Improvement program in the undergraduate category, the courses and curriculum. The total list will be 30 or 40 projects that are underway. The reports of these will appear at different intervals.

CURRICULUM DEVELOPMENT FUNDING

Mr. **Lewis**. Do you have a dollar amount before we go any further?

Dr. **Williams**. Yes, I have, K-to-12 and undergraduate, this is on curriculum development, K-to-12, this is 1992, 1993 and 1994; 1992, K-to-12 is $41 million, undergraduate is $18 million; 1993, the numbers are $40 million and $18 million; 1994, $45 million and $25 million.

Mr. **Lewis**. Can you give me a feeling for how those monies flow? Is the money spent in high percentages within staff organizations here in D.C, or is it States or school districts?

Dr. **Williams**. Almost entirely.

Mr. **Lewis**. And are those individual districts?

Dr. **Williams**. They are scientists and mathematicians and occasionally engineers at universities that work out a program with the local school districts to involve the local schools and that is the person who is leading the project.

I will give you an example of a project in California that is exemplary. We have a comprehensive math project where we are asking the question of whether it is problem to eliminate tracking grades 9 to 12.

It involves a series of schools in suburban and inner city schools in northern California. It involves all the students in these seven schools, grade 9 through 12 and all the math teachers. And the principal producers of the material who are doing it on a real-time basis are three or four mathematicians at San Francisco State. That is an example of a project that we do.

Mr. **Lewis**. So let's say that a local college, even a community college in the heart of Los Angeles, has a project specifically focusing upon science and math curriculum development for minority, highly impacted minority schools in X-district. They could be among those recipients for this kind of program?

Dr. **Williams**. Yes, in fact we expect it. There is a dissemination requirement. So we spend the money to have someone develop the inner school math curriculum, and the challenge is to make sure that it is broadly used.

Mr. **Lewis**. Thank you.

AMERICAN SCIENCE/MATH TEST SCORES VS OTHER COUNTRIES

Mr. **Stokes**. Let me ask you this, frequently we read that American students, not minority students, American students in international testing, both in science and math, when tested in conjunction with West Germany, Korea, Asian countries, Japan, in some cases the Soviet Union, are always last in terms of both math and science in international testing. Tell us why.

Dr. WILLIAMS. I don't know why, but I will give you three points in reaction. One, you have to recall in those assessments, certainly the most comprehensive one, the one that was released in March of 1992, the best American students scored as well as the top students in any country. So disallow that. The top 10 percent of American students.

The problem is with the other 90 percent. It is not so much the individual rating, it is that the spread of American students from the highest to the lowest is greater than it is in any other country. It is a situation where 50 percent of our students are in the lowest quadrants. Explanations are many.

There are important differences between our educational system and that of Asian and European countries. First, at least for students who stay in serious science and math programs, there is no tracking. We have an educational system where one can enroll in courses that range from serious mathematics to family math. And the difference between the two is enormous. But all of those students participate in the educational system and they are part of the assessment. So we don't have an organized grade-by-grade curriculum. And obviously we have multiple educational tracks, so within each school what we are really constructing is five different educational programs, and you refer to it generically as a school, but it might as well be six schools in terms of expectations of the students, all of which constitute an aggregate and when they take an exam, the performance reflects it.

The second thing is that most countries, if they don't have national curriculums, they have agreed on national standards; what it is that they desire students know at the end of elementary, high school. And we are just moving to that.

EDUCATIONAL STRUCTURE

Mr. STOKES. When I referred earlier this afternoon to Dr. Powell's statement about letting our students off the hook at 16, that is part of the problem; is not it?

Dr. WILLIAMS. Well, yes, except the issue is not at age 16. The issue is about age 11. It is about fifth grade. That is when America takes one elementary and middle school and converts it into six: and the youngster at fifth grade can decide to be a serious science and math student, or at the fifth grade one can decide basically to do nothing. And that is perfectly acceptable.

Mr. STOKES. Does this have anything to do also with the fact that today in the engineering schools throughout the United States over 50 percent of the engineering students are foreign students?

Dr. WILLIAMS. Well, I would not—others can answer—I would not presume to recite the correlation but clearly there has to be one of some value.

Mr. LEWIS. Would the Chairman yield?

Mr. STOKES. Certainly.

Mr. LEWIS. I just learned that the D.C. school system sent out a letter to the parents of ninth graders suggesting that students who have demonstrated ability or propensity in science attend a magnet school.

Dr. WILLIAMS. It is late, but there is not much to recommend that process. What we want to do is to allow the ninth graders at least to experience serious ninth grade mathematics. This is still a tracking mechanism even at grade 9.

GRADUATE TRAINEESHIPS

Mr. STOKES. The NSF requests a total of $9 million for graduate research traineeships in fiscal year 1994. This is $4 million more than had been allocated in the fiscal year 1993 plan. Is that correct?

Dr. WILLIAMS. Yes.

Mr. STOKES. The committee understands that the $23 million appropriated in fiscal year 1992 for this program was used to fully fund education for 125 students. Is that figure correct?

Dr. WILLIAMS. Two hundred for five years.

Mr. STOKES. Two hundred for five years?

Dr. WILLIAMS. Yes.

Mr. STOKES. In fiscal year 1993, NSF allocated $5 million to fund the first year only for an additional 125 students.

Dr. WILLIAMS. Two hundred.

Mr. STOKES. Two hundred there. Okay.

In fiscal year 1994, NSF proposed using $5 million to fund the second year, the fiscal year 1993 class and 4 million to fund the first year of the 1994 class of still 125 or 200?

Dr. WILLIAMS. One hundred and eighty.

Mr. STOKES. What would be the total number of graduate traineeships funded after four years in fiscal year 1995?

Dr. WILLIAMS. Eight hundred, approximately. If the increment is such.

Mr. STOKES. What critical fields does this program address in fiscal years 1992 and 1993?

Dr. WILLIAMS. Perhaps one of the other ADs would like to respond, but each of the Assistant Directors identified areas in which they desired to have the program concentrate on.

One of the things that we attempted to do, was to make provisions for students to have industrial experiences. But it is a fairly focused program. If you would like, certainly from the first awards since we have completed those, we could provide a list of the awards and give you a sense of those; the areas of science and engineers from which they are coming.

Mr. STOKES. That would be good.

[The information follows:]

GRADUATE RESEARCH TRAINEESHIPS [GRT]

In contrast to the FY 1993 competition, the FY 1992 competition did not specifically target any disciplines. Proposers were required to provide justification for considering their research areas as having national priority.

Since award recommendations from the initial competition are still being processed, we are providing a breakdown of sub discipline areas recommended for funding by each directorate. A complete awards list will be provided to the committee as soon as it is available.

Biological Sciences: Cell and Developmental Biology, Computational Biology, Cellular and Molecular Neurobiology, Plant Biology, Ecology & Conservation of Biodiversity, Mathematical Biology, and Plant Genetic Resource.

Computer and Information Science and Engineering: Computation & Neural Systems, Telecommunications, and Scientific Computing & Computational Mathematics.

Engineering: Design & Manufacturing, Nonlinear Dynamics, Tribology, Biomedical Engineering, Energy Efficiency & Environment, Environmental Engineering, Molecular Bioengineering, and Fire Protection Engineering.

Geosciences: Atmospheric Chemistry, and Quantitative Containment & Hydrology.

Mathematics and Physical Sciences: Inorganic Materials Chemistry, Instrumentation/Complex Physical Phenomena, Composites, Materials Science & Engineering, Molecule-based Electronics, Molecular Surface Chemistry, Applied Mathematics, Cross-Disciplinary Statistics, Environmental Chemistry, Adaptive Optics, and Optical Science.

Social, Behavioral and Economic Sciences: Basic Research in Family and Life, Economics of Education, Training and Human Resources, Minority Politics, Cognitive Psychology, Political Economy, and Environmental Sociology.

The following areas are being targeted in the FY 1993 GRT competition:

Education and Human Resources: Innovation in Teaching and Learning (including assessment of student learning and research in knowledge transfer and knowledge utilization).

Biological Sciences: Environmental Biology, Plant Biology.

Geosciences: Hydrology, Atmospheric Chemistry.

Social and Behavioral Sciences: Cognitive Science, Organizational Effectiveness.

Mathematics and Physical Sciences: Environmental Physical and Mathematical Science and Engineering (an interdisciplinary approach to environmental research), Integrating High Performance Computing into Research.

Engineering: Machine Tool Research, Environmentally Friendly Technology.

Computer Science: Human-Computer Interface (HCI), Robotics/Intelligent Control.

Mr. STOKES. What are NSF's criteria for identifying a field as "critical"?

Dr. MASSEY. I don't think we have picked out particular fields. We have asked that the institutions in their proposals identify factors and make the argument for the criticality in particular areas. We did not limit the traineeships to particular fields in the initial competition.

Mr. STOKES. Dr. Massey, let me ask you, do you believe that there are critical shortages in the fields funded by NSF?

Dr. MASSEY. Not overall right now in this economy. But you have to realize that we are thinking about the future in these areas. And it is very difficult to predict employment patterns in the future. So we see our goal in these areas as identifying talented people in areas that we know are going to be important for the Nation and funding them.

FUNDING EDUCATION AND HUMAN RESOURCES

Mr. STOKES. Of the total request for education and human resources, how much will be used for ongoing projects; that is, the second or third year of a multiyear grant or cooperative agreement, and how much will be allocated to new projects?

Dr. WILLIAMS. Two-thirds.

Dr. MASSEY. Ongoing?

Mr. STOKES. About two-thirds.

Mr. Lewis, anything else?

Mr. LEWIS. I think that is it, Mr. Chairman.

Mr. STOKES. Dr. Massey, we have completed our hearing. I certainly want to take this opportunity to say on behalf of all of us, this subcommittee, what a pleasure it has been to have had you appear before us during your stay here at NSF. All of us, of course, are proud to see you move on to the State of California, where you will continue the outstanding service you rendered to this Nation. And I just want you to know that we have enjoyed the opportunity to have you appear before us.

Dr. MASSEY. I certainly have appreciated the support and I have learned a lot from you.

Mr. LEWIS. Mr. Chairman, if I could add to that.

Dr. Massey, I would like to echo the Chairman's comments. I have a special feeling in my heart for Old Blue, so welcome. Any special concentration that might be directed towards UCLA would be appreciated.

Mr. STOKES. Mr. Livingston has made a request of us to have certain questions answered in the record for him. And without objection, I will enter those questions into the record at this point.

[The information follows:]

QUESTIONS FOR THE RECORD FROM CONGRESSMAN BOB LIVINGSTON

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY (LIGO)

MR. LIVINGSTON: Briefly summarize the key reasons given by the National Science Board when they approved the construction of the Laser Interferometer Gravitational-Wave Observatory (LIGO) Project.

ANSWER: The National Science Board discussed and approved the LIGO construction project at the May 1990 meeting. The Board felt that high risk, high cost research was part of their responsibility, including the responsibility to review and monitor the project.

The Board recognized that the ultimate objectives of the LIGO program include 1) tests of Einstein's General Theory of Relativity - in particular, measurement of the velocity and polarization of gravitational radiation and studies of the domain of highly non-linear, dynamic gravity, and 2) the opening of an observational window on the universe that differs fundamentally from that provided by electromagnetic or particle astronomy. LIGO will be used for research into the nature of gravity.

The Board felt it should endorse opportunities such as this where the quality of and potential for science are ripe for exploitation and the project was technologically exciting. LIGO offered an exciting new way to do science, and the potential to truly change science at the cutting edge.

MR. LIVINGSTON: Are these reasons still valid today?

ANSWER: Yes, they are. Further research has reinforced the technical strength and prospects for scientific discovery. Developments in optics and lasers has increased confidence in the basic design. Calculations concerning the sources of gravity waves have firmed the estimated signal rates.

BENEFITS OF LIGO

MR. LIVINGSTON: What are the benefits and possible payoffs to science and new U.S. technology in building LIGO?

ANSWER: Gravitational waves were first predicted by Einstein in 1918, and are as central to fundamental gravity physics as radio waves are to electromagnetism. So far, convincing but indirect evidence of their emission has been seen in the motion of astronomical bodies. Their direct detection is extremely difficult and technically challenging, but confirmation of the predicted properties (velocity, polarization, amplitude) will be a major landmark in the history of science. The strongest natural sources of gravitational radiation are expected to be astronomical objects which are fascinating and otherwise unobservable (black holes, cores of supernovae, coalescing stars, remnants of the early universe). Consequently, there is also high potential for exciting fundamental discoveries in astronomy to emerge. These scientific goals continue to drive the development of ultra-precise measurement technology.

This research is stimulating the development of enabling technology with potential for industrial, defense, and space applications:

-high precision metrology (the science of measurement);
-high efficiency lasers;
-high power lasers, mirrors, optical components and coatings;
-highly stabilized lasers (useful for spectroscopic research and communication);
-vibration isolation systems (useful for semiconductor chip making and processing, precision machine tools, electron microscopy and fundamental research);
-sensor development; and
-cost-effective methods for large-volume, high-quality vacuum systems (useful for space and defense research).

LIGO SITE IN LOUISIANA

MR. LIVINGSTON: As I understand, at the Louisiana site surveying has been conducted and clearing for construction has begun. I am also told that the Louisiana Legislature has authorized funds to provide an access road to the LIGO site in Livingston Parish. Briefly summarize the next steps in the construction process.

ANSWER: Contracts have been awarded to consultants to investigate engineering and environmental characteristics and prepare environmental documentation. After the State of Louisiana obtains title to the site, construction preparation will begin. By the end of 1993 the following will be accomplished: completion of the engineering design for site preparation, completion of the earthwork and initiation of the beamtube installation as the schedule and funding allows.

Mr. STOKES. That, then, concludes our hearing and the committee is adjourned until Monday at 2:00 p.m.

[Questions and budget justifications for the record follow:]

QUESTIONS FOR THE RECORD FROM CONGRESSWOMAN KAPTUR

INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES

MS. KAPTUR: During a meeting I attended with the Toledo Edison Industrial Systems, the technology transfer organization of the universities and businesses in Northwest Ohio, a question was raised on leveling the playing field with respect to technology transfer. There is the concern that other countries' research is not readily available to the United States while the United States is more open in allowing access to its research.

Does NSF's International Cooperative Scientific Activities program contribute to better access for American researchers to other countries' research? In your opinion, how open are other countries to allowing U.S. Researchers access to their research?

What kind of research access do United States government laboratories and private companies give to other countries?

ANSWER: Recently a policy directive was issued concerning the Foundation's international responsibilities, which recognizes that knowledge of and participation in international activities are essential to the health of U.S. science and engineering. It encourages all NSF programs to take responsibility for promoting access by U.S. scientists and engineers at sites throughout the world.

The fruitful interactions that the U.S. community has enjoyed with foreign colleagues cannot be taken for granted. One outcome of current political and economic changes throughout the world is an expansion and enrichment of the overall R&D environment and a growing confidence among foreign scientists and engineers in their ability to carry out major projects independently. NSF is carrying out special efforts to encourage overseas research cooperation by the U.S. research community.

Because of the size and strength of its research enterprise, the United States remains a highly desirable collaborator for other countries. Consequently, other countries have been open to joint research opportunities and to providing U.S. researchers access to their research. U.S. Government laboratories and private companies generally find it to their advantage to provide open access to researchers from other countries, except in areas constrained by proprietary or national security concerns.

NSF's International Cooperative Scientific Activities supports cooperative research that involves a balanced partnership between U.S. and foreign researchers and institutions, designed to take maximum advantage of the special capabilities of each partner. Such projects result not only in the advancement of knowledge and continuing research opportunities, but also in strong international professional and institutional relationships that maintain access for American researchers to overseas laboratories and research communities.

Recently, the International Cooperative Scientific Activities program has given high priority to overseas opportunities for researchers early in their careers, through fellowships and participation in cooperative research projects. Such early opportunities are central to U.S. researchers' willingness to seek overseas access throughout their careers.

DEFENSE CONVERSION

MS. KAPTUR: The Advanced Research Projects Office (ARPA), the Department of Energy, NIST, NASA and NSF are collaborating on President Clinton's defense conversion program. What will NSF's role be?

ANSWER: To help implement the defense conversion strategy outlined by the Clinton administration, a total of $465 million will be made available in fiscal year 1993 for the Technology Reinvestment Project (TRP), which will be administered by the newly formed Defense Technology Conversion Council (DTCC). Chaired by the Advanced Research Projects Agency, DTCC includes the Department of Energy, the National Institute of Standards and Technology, the National Aeronautics and Space Administration and the National Science Foundation. Linked by a "Memorandum of Understanding," DTCC members will act in concert to solicit, evaluate and select proposals.

NSF will help coordinate and administer all eight programs covered by TRP, including:

- Defense Dual Use Critical Technology Partnerships ($81.9 million) to develop technologies that have both military and commercial applications.

- Commercial-Military Integration Partnerships ($42.1 million) to develop dual-use technologies with clear commercial viability and potential military applications.

- The Regional Technology Alliances Assistance Program ($90.5 million) to bring state, industry and federal resources together to provide key infrastructure services to regional clusters of associated firms attempting to commercialize critical dual-use technologies.

- Defense Advanced Manufacturing Technology Partnerships ($23.5 million) to develop new manufacturing technologies with dual-use applications; particular emphasis is to be placed on significantly reducing health, safety and environmental hazards associated with existing manufacturing processes.

- Manufacturing Extension Programs ($87.4 million) to assist small manufacturers in upgrading their capabilities to serve both commercial and defense needs.

- The Defense Dual Use Assistance Extension Program ($90.8 million) to assist businesses economically dependent on DOD expenditures to acquire dual-use capabilities through a variety of assistance mechanisms.

- The Manufacturing Engineering Education and Training Program ($43.6 million) to support manufacturing engineering education and training at institutions of higher education.
- Manufacturing Experts in the Classroom ($4.6 million) to support teaching, curriculum development and other activities of manufacturing experts with practical experience at institutions of higher education.

With respect to the last two programs, it is likely that NSF will be assigned a special coordination and implementation role, including receiving the funds from ARPA to execute the award phase of the programs.

CRITICAL TECHNOLOGIES INSTITUTE

MS. KAPTUR: Since last year, NSF has served as the sponsor of the Critical Technologies Institute (CTI). The budget indicates that the Institute hosted a critical technologies panel and a report is due this spring. Do you have advance word on what will be in this report? How is the Critical Technologies Institute working on the FCCSET initiatives?

ANSWER: NSF "sponsorship" consists only of serving as the contracting agency and providing financial oversight of the contract. The Office of Science and Technology Policy (OSTP) directs all the substantive activity of the CTI. The panel dealt with ways to assess better the relation of technology to the economy, and to formulate strategies to maximize the benefits of Research and Development (R&D) investments.

OSTP is organizing new activities at CTI to further develop specific portions of the FCCSET Advanced Manufacturing Initiative proposed for FY 1994. OSTP is also beginning to formulate an agenda for a variety of other support activities.

INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTERS

MS. KAPTUR: I am very interested in your university/industry cooperative projects. Please expand on your budget request of $1 million for this program. Where are the Industry/University cooperative Research Centers located? How will the Centers specifically contribute to "local economic development and the competitiveness of U.S. industry"?

ANSWER: The new Industry/University Cooperative Research Projects Program will increase the fundamental knowledge base that underlies new technologies by linking the ideas, skills, and facilities of university and industry researchers. Formal cooperative projects are proposed and performed by teams of university and industrial researchers. Together, they identify and perform unique research activities, translating basic engineering into technological knowledge. During the first year of the program, research will focus on advanced manufacturing technologies.

A list of the current Industry/University Cooperative Research Centers (I/UCRC), showing their locations, is attached. The centers have a long track record of leverage of industrial partnership support (approximately 15:1). There are many examples where I/UCRC research has led to implementation of new products and processes by the companies participating in the centers. For example, the I/UCRC for chemical process modelling and control at Lehigh University has developed a computer-based technique (called tendency modelling) which has been adapted by a graduate student who jointed Air Products(a large chemical manufacturing company) to enhance the efficiency of the chemical manufacturing process, saving Air Products approximately $2M per year.

In FY 1990,the State I/UCRC program was initiated to enhance regional economic development. The funding of the centers are equally shared by NSF, State governments, and industry. Industry provides significantly more additional support from new memberships and company sponsored research. Total industry support in FY 1992 was $4.1M compared to NSF and States total funding of $4.4M. Currently nine states and 136 companies participate in ten centers. A list of these centers follows.

STATE /INDUSTRY/UNIVERSITY COOPERATIVE RESERACH CENTERS (STATE/IUCRC)

1. CASE WESTERN RESERVE UNIV./ UNIV. OF AKRON	MICROSTRCTURE OF COMPOSITES
2. UNIVERSITY OF MARYLAND	ELECTRONIC PACKAGING
3. UNIVERSITY OF MASSACHUSETTS	INTELLIGENT INFORMATION RETRIEVAL
4. MICHIGAN STATE UNIVERSITY	POLYMER COMPOSITE PROCESSING
5. UNIVERSITY OF MISSOURI	CAPSULE PIPLELINE FOR COAL
6. NORTH CAROLINA STATE UNIVERSITY	NONWOVEN TEXTILES
7. UNIVERSITY OF OKLAHOMA	ROCK MECHANICS
8. UNIVERSITY OF ROCHESTER	ELECTRONIC IMAGING
9. SUNY-BINGHAMTON	ELECTRONIC PACKAGING
10. UNIVERSITY OF TEXAS-SAN ANTONIO	BIOMATERIALS

NSF IUCRC LIST

1/19/93

INSTITUTION	RESEARCH AREA	YEAR INITATED	DIRECTOR'S NAME
UNIV. OF MASS.	POLYMERS (PROPERTIES)	1980	Kantor
CASE WESTERN UNIV.	POLYMERS (APPLIED)	1981	Hiltner
NC STATE UNIV.	TELECOMMUNICATIONS	1982	Abbott
RUTGERS UNIV.	CERAMICS	1982	Niesz
GEORGIA TECH.	MATERIALS HANDLING	1983	Pence
PENN STATE UNIV.	DIELECTRICS	1983	Dougherty
COL. SCH. OF MINES	STEEL PROCESSING	1983	Krauss
UNIV. OF WASH.INGTON	PROCESS ANALYTICAL CHEM.	1984	Kowalski
NEW JERSEY INST TECH.	HAZARDOUS WASTE MGMT.	1984	Magee
UNIV. OF ARIZONA	OPTICAL CIRCUITRY	1984	Gibbs
NORTHWESTERN UNIV.	TRIBOLOGY	1984	Cheng
UNIV. OF ARIZONA	MICROCONTAMINATION CONTROL	1984	O'Hanlon
CARNEGIE-MELLON UNIV.	STEELMAKING	1985	Fruehan
NORTHEASTERN UNIV.	ELECTROMAGNETICS	1985	Silevitch
LEHIGH UNIVERSITY	INNOVATION MGMT.	1985	Bean
IOWA STATE UNIV.	NONDESTRUCTIVE EVALUATION	1985	Thompson
OKLAHOMA STATE UNIV.	WEB HANDLING	1985	Reid
LEHIGH UNIVERSITY	CHEM. MODELING & CONTROL	1985	Georgakis
ALFRED UNIVERSITY	GLASS RESEARCH	1986	Pye
U. OF TEXAS- ARLINGTON	ADV. ELECTRON DEVICES	1986	Mitchell
UNIV. OF TENNESSEE	MEASURE. & CONTROL ENG.	1986	Garrison
RUTGERS UNIV.	PLASTICS RECYCLING	1986	Saba
N. MEXICO INST. MINING	ENERGETIC MATERIALS	1986	Persson
U. OF FLORIDA/PURDUE U.	SOFTWARE ENGINEERING	1986	DeMillo
UC - BERKELEY	INTEGRATED SENSORS	1986	Muller
U. OF SO. CALIFORNIA	MANUFACTURING AUTOMATION	1987	Bekey
UNIVERSITY OF IOWA	SIMULATION OF MECH. SYSTEMS	1987	Haug
NC STATE UNIV.	ASEPTIC PROCESSING	1987	Swartzel
UNIV. OF COL.-BOULDER	MM & MICROWAVE CAD	1988	Booton
SUNY - BUFFALO	BIOLOGICAL SURFACE SCIENCE	1988	Baier
U. OF PITTSBURGH	PARALLEL & DISTRIBUTIVE SYS	1988	Chang
U. OF NEW MEXICO	MICROENGINEERED CERAMICS	1989	Smith
BROWN UNIV.	THIN FILM & INTERFACE	1989	Loferski
UC - SAN DIEGO	ULTRA HIGH-SPEED CIRCUITS	1989	Ku
GEORGIA TECH.	INFORMATION MANAGEMENT	1989	McCracken
WASH. STATE UNIV.	ANALOG/DIGITAL CIRCUITS	1989	Ringo
U. OF ILLINOIS - URBANA	AIR CONDITIONING	1990	Bullard
UNIV. OF CONNECTICUT	GRINDING	1990	Howes
UNIV. NO. TEXAS	MATERIALS CHARACTERIZATION	1990	McDaniel
EASTERN MICHIGAN UNIV.	COATINGS	1990	Jones
UNIV. OF MICHIGAN	MEASUREMENT TECHNOLOGY(CMM)	1990	Ulsoy
RUTGERS UNIV.	WIRELESS NETWORKS	1991	Goodman
NC STATE UNIV.	INTEGRATED PEST MANAGMENT	1991	Coble
UC - IRVINE	HIGH-SPEED IMAGE PROCESSING	1991	Ferrari
LEHIGH UNIVERSITY	POLYMER INTERFACES	1991	El-Aasser
UNIV. OF COL.-BOULDER	THIN FILM SEPARATIONS	1991	Noble
VILLANOVA UNIVERSITY	MICROWAVE COMMUNCIATION	1992	DiGiacomo
CARNEGIE MELLON	ADVANCED BUILDING	1992	Hartkopf
ARIZONA STATE UNIV.	HEALTH CARE MANAGEMENT	1992	Zuckerman

SMALL BUSINESS RESEARCH AND DEVELOPMENT PROGRAM

MS. KAPTUR: How does NSF reach out to small businesses to make them aware of programs such as the Small Business Research and Development program. Expand on NSF's technology transfer initiatives.

ANSWER: NSF, in conjunction with the Department of Defense, the Small Business Administration, and other Small Business Innovation Research program agencies annually conducts three major conferences across the country to assist small, technology based firms on how to participate in federal research and development programs, and the SBIR program in particular. These conferences include workshops in such areas as how to start and finance a small high tech firm, patents and protecting intellectual property, and government accounting requirements. The conferences also provide ample opportunities for business owners to ask questions "one-on one" with representatives from the various agencies.

NSF also works cooperatively with the National Governors Association and the individual states to provide information and assistance to potential SBIR applicants.

NSF's technology transfer activities build working relationships between academia and industry to enhance the transfer of knowledge to technological realization. The research that is funded is generic, long-term, and not product specific; some of it reaches the point of experimental testbeds, but remains precompetitive.

Some NSF programs, especially those in the Engineering Directorate, can be characterized as having an essential technology transfer component:

- Small Business Innovation Research (SBIR): This program moves basic research to the marketplace by supporting exploratory research to prove the technical feasibility of an idea.

- Industry/University Cooperative Research Centers (I/UCRCs). This program is designed to conduct industrially-relevant research to stimulate interaction between the university and the industrial community.

- Engineering Research Centers (ERCs). These centers support cross-disciplinary engineering that focuses on research and education in major technological areas important to U.S. industrial competitiveness. Investigators from both academic and industrial research labs collaborate on joint projects that move beyond the theoretical plan of research to experiment with proof-of concept principle, experimental prototypes.

GREAT LAKE RESEARCH

MS. KAPTUR: NSF has devoted $209 million to its Ocean Sciences initiative. What is NSF doing in the way of research in the Great Lakes.

ANSWER: The Ocean Sciences Subactivity currently provides support in the amount of $829,000 for Great Lakes research and education. The University of Michigan receives $385,000 for support of the Research Vessel Laurentian and associated marine technicians; the University of Wisconsin at Milwaukee receives $50,000 for Research Experiences for Undergraduates, supporting 10 students; and $ 395,000 supports research on the planktonic ecosystem and food chains, nutrient loading and climate, and paleolimnology.

INVESTIGATOR INITIATED RESEARCH

MS. KAPTUR: Last year NSF supported an approximately 17% increase in investigator initiated research. Some in my community felt that number should be higher. This year, investigator initiated research is only receiving a 5% increase. How do you account for a smaller percentage increase in FY 1994 than in FY 1993?

ANSWER: NSF's Request for FY 1994 includes a 7 percent increase over the FY 1993 Revised Current Plan for investigator initiated research across the Foundation. However, this represents a more than 20 percent increase over the FY 1993 appropriated level. The President's stimulus request for FY 1993 includes $197 million for support of individuals and small groups of researchers.

ADVANCED MANUFACTURING TECHNOLOGIES

MS. KAPTUR: Please elaborate on your interagency Advanced Manufacturing Technologies Initiative.

ANSWER: The strategic objective of the interagency Advanced Manufacturing Technology (AMT) Initiative is to develop a coherent and synergistic interagency program in advanced manufacturing technology R&D, by combining and integrating federal efforts. The program will accelerate the development and application of new manufacturing technologies to the domestic manufacturing base and to the missions of the participating agencies. The President's FY 1994 Budget Request for the AMT initiative is $ 1.225 Billion. Of that amount, NSF is requesting a total of $130.3 million, an increase of $17.6 million or 15.6 percent over the FY 1993 Revised Current Plan (includes supplemental request) of $112.7 million.

Initially, R&D activities will focus on three thrust areas. These areas were selected by an interagency committee, based on technological opportunities and anticipated technical needs as identified by the manufacturing community.

"Intelligent" manufacturing cells: The next generation of manufacturing "cells" (or sub-systems) will enable major improvements in product quality and manufacturing output and flexibility, while reducing costs, for moderate- to low-volume technology applications.

Integrated tools for product, process, and enterprise design: Just as computer-aided design and engineering tools have revolutionized product design during the past decade, computer-based hardware and software tools for production design can revitalize manufacturing.

Advanced manufacturing technology infrastructure: Approaches may include: technology deployment mechanisms; education and training; and development of benchmarks or metrics that could be used to evaluate the effectiveness of manufacturing improvements.

Industry has been involved in the planning process, as permitted by federal regulations. Industry representatives originally proposed many elements of the AMT initiative and have conducted a limited program review. In the future, industry will play an expanded role in defining AMT priorities and suggesting R&D strategies and programs. The planned industry-led institute for agile manufacturing will facilitate this.

ENGINEERING RESEARCH CENTERS

MS. KAPTUR: The budget requests $52.50 million for the Engineering Research Centers (ERCs), which will increase the number of Centers from 18 to 20. The new ERCs will be focused on manufacturing, materials processing, and high performance computing and communications. How are the locations of the ERCs determined?

ANSWER: The institutions that receive awards to establish ERCs are selected through NSF's merit review process. The criteria used in the review of proposals are drawn from guidelines in the NSF document Grants for Research and Education in Science and Engineering, and from the definition of the key features of an ERC. These are, in order of priority:

1. The intrinsic merit of the research program and its impact on US. competitiveness.
2. The strength and impact of the educational program.
3. The utility, relevance and strength of industrial interaction.
4. Leadership and performance competence.
5. Institutional environment and support.

6. The impact on the infrastructure of engineering.

7. Special criteria for existing ERCs seeking new ERC awards (i.e. the quality of a Center's past performance, as well as its potential to deliver high-quality innovations in the future).

The best proposals are selected for award independent of locality.

QUESTIONS FOR THE RECORD FROM CONGRESSMAN GALLO

SUPPORT FOR COMMUNITY COLLEGES

MR. GALLO: I strongly believe in promoting science and engineering education at all levels of our nation's education system and the National Science Foundation is critical to this goal. For instance, I know that a variety of educational institutions in New Jersey, including community colleges, have successfully competed for NSF grants. What portion of the NSF budget, either as a percentage or total dollar amount, is appropriated for grants to our nation's community colleges?

ANSWER: Community colleges received $7.3 million in FY 1992.

MR. GALLO: Do you believe that is an appropriate level of NSF activity at community colleges or should it be increase?

ANSWER: We believe it should increase, and our FY 1994 Request focuses more attention on this area. With our plan to implement efforts for advanced technician training, we estimate the FY 1994 funding at two-year colleges will increase to about $12 million.

MR. GALLO: Do you believe community colleges are fully aware of, and avail themselves to, the opportunities provided by NSF?

ANSWER: We believe that community colleges could avail themselves further of NSF's resources. We have been working to increase awareness in the two-year college community about NSF programs and funding activity. In addition, several community college faculty have, over the past two years, served as fellows in Washington at NSF. These fellows have been learning about the Agency, developing outreach activities, and serving as liaisons with the two-year college community.

NATHANIEL B. PALMER

MR. GALLO: The NSF's newest icebreaking vessel, the NATHANIEL B. PALMER, is approaching the anniversary of its first year in service. It is my understanding that this vessel has performed in excess of the NSF's expectations. How would you rate the performance of this vessel?

ANSWER: We are very pleased with the Nathaniel B. Palmer's performance and think it has the potential to be an excellent research ship. There are, as is common with new ships, a few bugs that need to be worked out such as the poor performance of acoustic depth finding equipment at cruising speed. But the scientists who use the ship are enthusiastic about its research capabilities.

ARCTIC & ANTARCTIC RESEARCH VESSELS

MR. GALLO: It is also my understanding that the NSF has a requirement for two additional vessels with icebreaking capability. Is the NSF's request for these additional vessels included in its budget request for FY'94?

ANSWER: Only one additional vessel with icebreaking capability is needed. The NSF has requirements for an Arctic Research Vessel with the ability to work independently year around in the seasonally ice-covered areas of the Arctic, capability to support general purpose research for both water column and seafloor studies, and capabilities to work in ice-free as well as ice-covered regions. The FY 1994 budget request includes $6.5 million for the initial steps of the procurement of this Arctic Research Vessel, as part of the academic fleet in the Ocean Sciences Subactivity. Additional funds in subsequent years will be required to complete the acquisition of the vessel either through purchase, lease/purchase or charter.

In the Antarctic Program, a successor for the currently leased Polar Duke, the second vessel referred to in your question, will be sought. The lease for Polar Duke, which has been used in the Antarctic for research and to resupply Palmer Station, will expire in December, 1994.

However, while Polar Duke is ice-strengthened, it has very limited icebreaking capability, nor is icebreaking required of its successor. Polar Duke was leased originally to resupply Palmer Station and operate in the Antarctic Peninsula area in the austral summer to support research. It came to play a major role in antarctic ocean research. The support contractor, Antarctic Support Associates, will initiate shortly a competition for a successor ship to Polar Duke. In addition to resupplying Palmer Station, which has a summer population of about 3% the size of that of the main U.S. base, McMurdo, the successor ship will be used for research not requiring icebreaking capability. The annual operating cost of Polar Duke is about one third that of the Nathaniel B. Palmer, and the intent is to obtain a replacement that costs no more than Polar Duke because of the large annual investment required to support research from the R/V Palmer and because there are alternatives to a Duke-like ship. (Prior to Duke's advent on the antarctic scene, Palmer Station was supplied by an annual visit of a Coast Guard icebreaker, and by a 100 foot trawler, Hero.) The lease of the successor to Polar Duke will not begin prior to FY 1995, so only funds for the Duke lease are included in the FY 1994 request.

MR. GALLO: I believe it is important that these vessels are built in the U.S. Do you agree and will your procurement process follow the same requirements used in the construction of the NATHANIEL B. PALMER?

ANSWER: NSF through the University-National Oceanographic Laboratory System (UNOLS) is supporting a community based study for the Arctic Research Vessel to: (1) update and refine the scientific mission requirements for the ship, (2) provide a conceptual design for the ship which outlines power, laboratory space, size, and other physical characteristics to meet science requirements, and (3) a preliminary design for the ship which advances the engineering work to the stage ship yard bids for purchase, lease purchase, or charter specifications can be specified. The bid package will be responsive to Congressional guidance.

For the Antarctic, the Polar Duke successor is much less specialized than the arctic vessel, and the existence of ships which might serve as its successor means that new construction may not be required and may be undesirable because of cost. Because the U.S. Antarctic Program is a national program, we plan to require a U.S. flagged vessel.

National Science Foundation

Justification of Estimates of Appropriations to the Congress

Fiscal Year 1994

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NATIONAL SCIENCE FOUNDATION: $3,180,200,000

The FY 1994 Budget Request for the National Science Foundation is $3.18 billion, an increase of $240.03 million, or 8.2 percent, over the FY 1993 Revised Current Plan of $2.94 billion.

(Millions of Dollars)

Appropriation	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan 1/	FY 1994 Request	Change	
					Amount	Pcnt
Research and Related Activities	$1871.14	$2,211.50	$2,056.23	$2,204.80	$ 148.57	7.2
Education and Human Resources	441.42	479.50	487.50	556.10	68.60	14.1
U.S. Polar Research Programs	77.37	93.00	158.00	163.10	5.10	3.2
U.S. Antarctic Logistics Activities	10.00	70.00	63.36	65.10	1.74	2.7
Academic Research Facilities and Instrumentation	33.36	33.00	54.70	55.00	0.30	0.6
Critical Technologies Institute	0.00	1.00	1.00	1.00	0.00	0.0
Salaries and Expenses	109.99	135.00	115.70	125.80	10.10	8.7
NSF Headquarters Relocation	0.00	0.00	0.00	5.20	5.20	N/A
Office of Inspector General	3.86	4.00	3.69	4.10	0.41	11.1
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Total, National Science Foundation ...	$2,547.13	$3,027.00	$2,940.17	$3,180.20	$240.03	8.2

1/ Revised Current Plan amounts exclude carryover unobligated balances from FY 1992.

The National Science Foundation -- whose mission is to promote the progress of science and engineering -- provides support for a broad range of research and education activities in all fields of the natural and social sciences, mathematics, and engineering. In addition, NSF is the only Federal agency mandated to strengthen the nation's overall potential in science and engineering. These responsibilities give NSF a central role in determining the nation's ability to realize the benefits that result from new discoveries and advances in knowledge.

America's capabilities in science and technology have long been a steady driver of economic growth, productivity gains, new job opportunities, rising living standards, and improved quality of life. Over four decades of investment in science and engineering by NSF and other Federal agencies has underpinned the development of a base of human resources and intellectual capital that is unmatched in human history.

Ensuring that the nation's capabilities in science and technology remain of the highest quality requires sustained, long term investments in research and education. Such investments provide researchers with the resources, independence, flexibility, and infrastructure needed to extend the frontiers of knowledge and address critical priorities. Also essential is investment in an educational system that enables and inspires more students to pursue opportunities in science and engineering.

All indications are that the importance of science and technology in determining national well-being will only increase in the years ahead. Many areas vital to the nation's future -- from nurturing new industries with high-skill, high-wage jobs, to developing advanced, environmentally-compatible manufacturing techniques, to creating faster, more efficient modes of transportation and information exchange -- require continued progress in fundamental research across a range of disciplines and the adoption of innovative, forward-looking approaches to education and training.

It is therefore vital that the nation constantly strive to enhance its underlying capabilities in science and technology. NSF recognizes that the vision which has guided it for over 40 years must be focused on new strategies that enrich the national welfare and help to define a new working relationship in science and technology between government, academe, and the business-industrial enterprise.

GENERAL STRATEGIES FOR INVESTMENT IN FY 1994

From the work of the Commission on the Future of NSF and internal planning discussions, NSF has developed three strategies to guide its budgetary and programmatic decisions in Fiscal Year 1994:

- Enhancing the nation's fundamental science and engineering capability,
- Investing in people, and
- Addressing critical research and technology priorities.

These strategies build upon the agency's historical success and foster new directions that reflect the increasing importance of science and technology. Not only do they describe the variety of activities supported by the Foundation, but they also provide guidance on how the agency should structure its investment in the Nation's scientific and technological enterprise. These strategies are highly complementary and overlapping; each spans a broad range of programs and budgetary categories. Furthermore, each strategy is fundamental to increasing both the short and long term payoffs from public investments in research and education.

Enhancing the Nation's Fundamental Science and Engineering Capability

Strengthening the nation's capabilities in fundamental science and engineering remains an overarching priority for the Foundation. NSF is a critical component of America's research and higher education system, a system which provides a model for the entire world. No other nation so successfully provides scientists, engineers, and educators the opportunity to compete openly on the basis of merit for support. This provides a remarkably effective and efficient means of sustaining a continuing supply of new ideas and talent -- the cornerstones of innovation and progress.

NSF's research programs aim to provide broad flexibility to researchers in order to accommodate emerging trends in the conduct of research -- notably the increased interdependence of science and technology and rise of interdisciplinary and collaborative research. NSF research grants range from small, short-term grants for exploratory work to traditional individual investigator awards to grants for centers involving researchers from both academe and industry. Additionally, the large-scale research facilities and information processing capabilities supported by NSF -- such as observatories, research ships, supercomputer centers, and advanced communications networks like the Internet and NSFNET -- facilitate cooperation among researchers and build strong links between scientific research and technology development.

The proposed budget for FY 1994 will enable NSF to fund more than 22,200 awards, enhancing the nation's fundamental science and engineering capabilities and providing for increased investments in research activities and state-of-the-art instruments and facilities.

Investing in People

Perhaps no strategy encompasses more of what NSF is and does than "Investing in People." Nearly every dollar spent by the Foundation is in some way an investment in education and training: research grants provide support for senior scientists and engineers, post doctoral researchers, technicians, graduate students, and, in certain instances, undergraduate and high school students; in addition, NSF's focused education and human resource programs provide direct support to teachers and students at all grade and achievement levels and in all regions of the country.

Under the FY 1994 budget, it is estimated that NSF's programs will reach upwards of 110,000 people, ranging from senior scientists working at major universities to high school students participating in science summer camps.

The importance of this investment cannot be overstated, nor can the need for improved programs and innovative approaches to teaching and learning. Today, our society needs not only experts in science and technology, but a scientifically literate and technically capable populace as well. Our workforce needs the more flexible, higher-order skills required to increase productivity in the modern work environment. And we need broadened opportunities in science and technology for people of every race, gender, and background.

NSF's focused programs in education and human resources address these challenges by providing leadership and encouraging reform on a systemic basis in states, major cities, and at colleges and universities.

- In precollege education, the FY 1994 budget provides continued support for the Statewide Systemic Initiative in approximately 25 states and will allow NSF to expand its Urban Systemic Initiative program into approximately eight major cities.

- Reform of undergraduate and graduate education will be accomplished through the establishment of projects to reform teaching in specific disciplines and, up to two new engineering education coalitions, and a traineeship program that encourages industrial participation.

- A new program, Model Institutions of Excellence (MIE), will provide support to minority institutions for model programs to improve the recruitment, academic environment, and retention of undergraduates in science, mathematics, and engineering.

All of NSF's efforts in these areas are carried out in conjunction with other Federal agencies through the government-wide initiative in Math and Science Education coordinated by the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). In FY 1994, NSF is expected to contribute approximately 26 percent of the total Federal funding for these national initiatives.

Addressing Critical Research and Technology Priorities

Because the progress of science is closely tied to the application of new knowledge to the pressing concerns of society, strategic research on critical areas of national priority has become an integral part of the NSF portfolio. Indeed, the Commission on the Future of the NSF, in its report of December 1992, affirmed that NSF should provide "a balanced allocation of resources in strategic research areas in response to national needs."

Under the proposed budget for FY 1994, the Foundation will provide significant support for strategic NSF and interagency initiatives.

(Millions of Dollars)

Initiative	FY 1993 Estimate	FY 1994 Estimate	Change FY 1994 vs. FY 1993
Advanced Materials and Processing Program . . .	$318.50	$328.00	$9.50
Biotechnology	205.60	215.60	10.00
U.S. Global Change Research Program	162.50	170.05	7.55
High Performance Computing & Communications	261.17	304.96	43.79
Advanced Manufacturing Technologies	112.70	130.25	17.55
Math & Science Education	537.87	621.88	84.01

NSF's primary focus in the initiatives is on the fundamental research needed to further progress in these areas. These interagency initiatives, coordinated through the FCCSET, have ushered in a new era of cooperation among different government agencies, reduced unnecessary redundancies, and improved the interaction between researchers and users of research.

These strategic initiatives are designed to increase the potential for early application of newly discovered knowledge by promoting and facilitating cooperation between universities, industries, and government. For example, the High Performance Computing and Communications (HPCC) Initiative -- a centerpiece of the President's technology strategy -- will help to develop a more efficient means of access to information by all sectors of the economy. The budget request also includes $36 million to build upon the HPCC initiative by further developing applications which use advanced computers and communications networks to solve problems in healthcare, education, manufacturing, and access to libraries. Through the U.S. Global Change Research Program, NSF supports fundamental research that examines not only the scientific basis of global change but also its potential human impacts and policy implications.

Furthermore, all five initiatives devote significant resources to education and training, through such activities as curriculum development, outreach, and specialized research experiences. In every instance, the people participating in research receive valuable training and become available to contribute in all sectors of society.

BUDGET PRESENTATION

The Justification in support of the FY 1994 Budget Request is presented in the traditional manner to track from the FY 1993 enacted level of $2,733.6 million, to the FY 1993 Revised Current Plan level of $2,940.2 million which includes the FY 1993 stimulus package of $206.6 million, to the total FY 1994 Request of $3,180.2 million.

(Millions of Dollars)

Appropriation	FY 1993 Enacted Level	FY 1993 Stimulus	FY 1993 Revised Current Plan	FY 1994 Increment	Total FY 1994 Request
Research and Related Activities	$1,859.0	$197.2	$2,056.2	$148.6	$2,204.8
Education and Human Resources	487.5	0.0	487.5	68.6	556.1
U.S. Polar Research Programs [1/]	158.0	0.0	158.0	5.1	163.1
U.S. Antarctic Logistics Activities	63.4	0.0	63.4	1.7	65.1
Academic Research Facilities and Instrumentation	50.0	4.7	54.7	0.3	55.0
Salaries and Expenses	111.0	4.7	115.7	10.1	125.8
NSF Headquarters Relocation	0.0	0.0	0.0	5.2	5.2
Office of Inspector General	3.7	0.0	3.7	0.4	4.1
Critical Technologies Institute	1.0	0.0	1.0	0.0	1.0
Total, National Science Foundation ..	$2,733.6	$206.6	$2,940.2	$240.0	$3,180.2

1/ Account name changed from "U.S. Antarctic Program" to reflect inclusion of Arctic Research Program in this account beginning in FY 1994.

In order to tie the Foundation's Request to the President's Request, a reconciliation to the President's Budget is presented as follows:

(Millions of Dollars)

Appropriation	FY 1993 Enacted Level	Policy & Other Adjustments [2]	Revised FY 1994 Baseline	FY 1994 Investment	Total FY 1994 Request
Research and Related Activities	$1,859.0	$-24.7	$1,834.3	$370.5	$2,204.8
Education and Human Resources	487.5	11.9	499.4	56.7	556.1
U.S. Polar Research Programs	158.0	5.1	163.1	0.0	163.1
U.S. Antarctic Logistics Activities	63.4	1.7	65.1	0.0	65.1
Academic Research Facilities and Instrumentation	50.0	5.0	55.0	0.0	55.0
Salaries and Expenses	111.0	14.8	125.8	0.0	125.8
NSF Headquarters Relocation	0.0	5.2	5.2	0.0	5.2
Office of Inspector General	3.7	0.4	4.1	0.0	4.1
Critical Technologies Institute	1.0	0.0	1.0	0.0	1.0
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Total, National Science Foundation ..	$2,733.6	$19.4	$2,753.0	$427.2	$3,180.2

1/ Account name changed from "U.S. Antarctic Program" to reflect inclusion of Arctic Research Program in this account beginning in FY 1994.

2/ Reflects redirection of resources within the FY 1994 baseline.
R&RA adjustments include reductions of $59.5 million from government-wide savings and other efficiencies.
EHR adjustments include reduction $3 million from goverment-wide savings and other efficiencies.
S&E adjustments include an increase of $12 million for relocation offset by $3.5 million for administrative efficiencies.
Arctic Research Program transferred from Research & Related Activities appropriation to U.S. Polar Research Programs appropriation.

ACTIVITY SUMMARIES

RESEARCH AND RELATED ACTIVITIES

The FY 1994 Request includes $2,204.80 million for Research and Related Activities (R&RA), an increase of 7.2 percent over the FY 1993 Revised Current Plan. In FY 1994, approximately 65 percent of R&RA will support fundamental and strategic research by individuals and groups in traditional fields as well as in cross-disciplinary fields of national importance. Also included in R&RA is a $56 million increase in support for unique national facilities such as telescopes, research ships, and supercomputers, as well as an increase of more than $11 million for support for instrumentation and equipment, all of which enhance the research capabilities of the Nation's scientists and engineers.

An increase of almost $40 million, or more than 15 percent, will support activities associated with the FCCSET High Performance Computing and Communications initiative. Also included in the FY 1994 Request are increases for other strategic research initiatives, including Foundation efforts for research on the environment, civil infrastructure and intelligent systems, as well as the Presidential initiatives coordinated through the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). These strategic initiatives are supported within NSF and also by other Federal agencies.

Through its support for programs such as Engineering Research Centers, Science and Technology Centers, and Industry/University Cooperative Research Centers, the Foundation encourages the growth of partnerships among academia, industry and government. NSF also supports a number of innovative programs to support science and engineering training at the undergraduate, graduate and post-doctoral levels.

EDUCATION AND HUMAN RESOURCES

The FY 1994 Request for Education and Human Resources totals $556.10 million, an increase of 14.1 percent over the FY 1993 Revised Current Plan level of $487.50 million. Highlights include:

- an increase of $17.30 million, or 20.2 percent, for Systemic Reform activities including a major expansion of the Urban Systemic Initiatives Program begun in FY 1993.

- an increase of $17.00 million, or 34.8 percent, for expansion of targeted efforts to expand the participation of women, minorities and persons with disabilities in science and engineering.

- a 21.2 percent increase, or $13.10 million, for undergraduate education, including expanded support for course, curriculum and laboratory development; initiation of efforts in technical education; and increased support for K-12 teacher preparation activities.

- a $4.70 million increment for activities in high performance computing and communications directed to the establishment and enhancement of education networks.

U.S. POLAR RESEARCH PROGRAMS

The former "U.S. Antarctic Program" appropriation has been retitled "U.S. Polar Research Programs," due to its expanded role in funding polar research. The FY 1994 Request for U.S. Polar Research Programs totals $163.10 million, an increase of 3.2 percent over the FY 1993 Revised Current Plan level. This appropriation now consolidates funding for arctic research, which was formerly funded from the Geosciences Activity within the Research and Related Activities appropriation, and antarctic research and operations and science support. The request includes increases for the ice operations of R/V NATHANIEL B. PALMER, improved field party support, South Pole Station and communications facilities.

U.S. ANTARCTIC LOGISTICS ACTIVITIES

The FY 1994 Request for U.S. Antarctic Logistics totals $65.10 million, an increase of $1.74 million over the FY 1993 Revised Current Plan level. Because of their extent and remote location, U.S. activities in Antarctica require major logistic support. Of the funds provided under this activity, $59.10 million supports logistics provided by the Department of Defense and $6.00 million are for the final year of the Safety, Environment and Health (SEH) initiative. The Activity contributes to an active and influential U.S. presence in Antarctica as well as addresses environmental problems pre-dating NSF's management of U.S. antarctic logistics and operations.

ACADEMIC RESEARCH FACILITIES AND INSTRUMENTATION

The Request for Academic Research Facilities and Instrumentation (ARFI) for FY 1994 is $55.0 million, a $300,000 increase, or 0.5 percent, over the FY 1993 Revised Current Plan. ARFI will continue to support the development and acquisition of major research instrumentation and the modernization of research facilities. FY 1994 funds will be equally divided between facilities and instrumentation needs.

CRITICAL TECHNOLOGIES INSTITUTE

The Critical Technologies Institute, a federally-funded research and development center, will provide analytical support for technology assessment to the Executive Branch. NSF serves as sponsor for the Institute as mandated by the Department of Defense authorization Act for FY 1992. The FY 1994 Request for the Critical Technologies Institute is $1.0 million, the same level as in FY 1993.

SALARIES AND EXPENSES

The FY 1994 Request for Salaries and Expenses (S&E) is $125.80 million, an increase of $10.10 million, or 8.7 percent, over the FY 1993 Revised Current Plan of $115.70 million. Salaries and Expenses provides funds for staff salaries and other operating expenses necessary to manage and administer the Foundation's program responsibilities, but excludes funds for the Office of Inspector General, which are requested separately. In addition, S&E includes funds for general administrative costs, including information systems and FY 1994 rent on the new NSF headquarters building.

The Request includes funds for 1,203 full-time equivalent staff years who manage and support the programmatic and administrative activity of the Foundation. The Request reflects a reduction in FTEs from the FY 1993 Authorized level, consistent with Administration policies on reducing the size and cost of the federal government.

NSF HEADQUARTERS RELOCATION

The Request for the new NSF Relocation appropriation totals $5.20 million in FY 1994. This appropriation will provide funds for the first of five reimbursements to the General Services Administration, which provided the initial funding for the NSF relocation in FY 1992 and FY 1993 and the FY 1993 rental payments on the new building.

OFFICE OF INSPECTOR GENERAL

The Office of Inspector General (OIG) was established by the 1988 amendments to the Inspector General Act to promote economy, efficiency, and effectiveness in administering Foundation programs; to prevent and detect fraud, waste, abuse, and mismanagement; and to prevent, detect, and handle cases of misconduct in science. The FY 1994 Request includes $4.10 million for OIG, an 11.1 percent increase over the FY 1993 level.

FY 1993 Supplemental Request

The supplemental FY 1993 request will provide NSF with a unique opportunity to maintain the momentum for research investment that is critical to the long-term economic growth of the nation and maintain operations at the FY 1992 level.

(Millions of Dollars)

Appropriation	FY 1993 Request	FY 1993 Current Plan	FY 1993 Supplemental	FY 1993 Revised Current Plan
Research & Related Activities . .	$2,211.50	$1,859.00	$197.23	$2,056.23
Academic Research Facilities and Instrumentation	33.00	50.00	4.70	54 70
Salaries and Expenses	135.00	111.00	4.70	115.70
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Total, NSF	$2,379.50	$2,020.00	$206.63	$2,226.63

The supplemental FY 1993 request for the National Science Foundation totals $206.63 million, distributed to the following appropriations:

Research and Related Activities

The supplemental request for Research and Related Activities of $197.23 million will enable individual researchers and small groups of investigators to carry out fundamental and strategic research that generates new scientific and engineering knowledge. In FY 1992, the National Science Foundation (NSF) had $1 billion of unfunded proposals that were rated excellent by the science and engineering community. Thus, it appears that NSF has the capacity to invest more funds in a broad range of fields including: understanding the climate system, advanced supercomputers and digital computer networks, biotechnology, materials processing, advanced manufacturing, and math and science education.

- $112.1 million will be used to fully fund NSF's strategic research initiatives at the levels proposed in the FY 1993 Budget Request to Congress. These initiatives include: advanced manufacturing, global change research, materials research, biotechnology, and high performance computing and communications.

- $19 million of the high performance computing and communications initiative is targeted for networking and computer applications that address problems in health care, education, manufacturing, and access to data bases.

- $85.1 million will be used to augment NSF's core research activities, including such efforts as research on the environment.

- Funds will also be provided to NSF's SBIR program to develop research capabilities in small businesses and to meet the higher funding level mandated for the program.

FOUNDATION-WIDE SUPPORT FOR STRATEGIC RESEARCH INITIATIVES

(Millions of Dollars)

	FY 1993 Request	FY 1993 Current Plan	FY 1993 Supplement	FY 1993 Revised Current Plan
AMPP	$ 318.50	$ 303.58	$ 14.92	$ 318.50
BIOTECHNOLOGY	205.60	190.19	15.41	205.60
GLOBAL CHANGE	162.50	125.00	37.50	162.50
HPCC	261.17	225.17	36.00	261.17
MAUNFACTURING	112.70	104.37	8.33	112.70

Academic Research Facilities and Instrumentation

The supplemental request for Academic Research Facilities and Instrumentation of $4.7 million will be used, on a cost-sharing basis, to support the development and acquisition of major research instruments needed for university-based scientific and engineering research. These funds will help enhance research productivity and improve the research environment for the nation's scientists and engineers.

Salaries and Expenses

The supplemental request for Salaries and Expenses of $4.7 million will provide funds that support the development, management and coordination of the National Science Foundation programs. Because funding for this Appropriation is extremely constrained, we have reduced administrative services and eliminated a number of important program management positions. In addition, now that the relocation plans have been successfully concluded, funding is required for relocation related expenses beyond those that will be paid by the General Services Administration. Therefore, this supplemental request will eliminate the payroll shortfall as well as meet some of the requirements associated with relocation that have emerged since the approval of our Current Plan late last year.

NATIONAL SCIENCE FOUNDATION
Research and Related Activities

For an additional amount for "Research and Related Activities," $197,230,000.

This supplemental request would provide funds that contribute to the nation's productivity by generating new scientific and engineering knowledge and contribute to the development of the next generation of scientists and engineers. In FY 1992, the National Science Foundation (NSF) had $1 billion of unfunded proposals that were rated excellent by the science and engineering community. Thus, it appears that NSF has the capacity to invest more funds in a broad range of important research areas, including strategic research in improving our understanding of the climate system, advanced supercomputers and digital computer networks, biotechnology, materials processing, advanced manufacturing, and math and science education. These funds should be focused on research conducted by single investigators and groups, not on major facilities or equipment. This proposal would restore NSF funding to roughly the level that was planned for in FY 1993.

This proposal also includes $19,000,000 to build upon the High Performance Computing and Communications program and initiate projects among four Federal agencies (NASA, NSF, NIH, DOC) to develop applications which use advance computers and communication networks. These applications would be used to solve problems in health care, education, manufacturing, and access to libraries.

NATIONAL SCIENCE FOUNDATION
Academic Research Facilities and Instrumentation

For an additional amount for "Academic Research Facilities and Instrumentation," $4,696,000.

This supplemental request would provide funds that support the development and acquisition, on a cost-sharing basis, of major instruments needed in university-based scientific and engineering research.

NATIONAL SCIENCE FOUNDATION
Salaries and Expenses

For an additional amount for "Salaries and Expenses," $4,694,000.

This supplemental request would provide funds that support the development, management, and coordination of the National Science Foundation programs. This proposal will eliminate the payroll shortfall which has resulted from reductions by the Congress in FY 1993.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	FY 1993 REVISED CURRENT PLAN 1/
BIOLOGICAL SCIENCES					
MOLECULAR AND CELLULAR BIOSCIENCES					
Biochemistry and Molecular Structure and Function	$33,577	$37,960	$33,160	$2,143	$35,303
Cell Biology	19,017	22,080	18,780	1,620	20,400
Genetics and Nucleic Acids	30,539	35,460	30,170	2,330	32,500
Total	83,133	95,500	82,110	6,093	88,203
INTEGRATIVE BIOLOGY AND NEUROSCIENCES					
Physiology and Behavior	30,184	35,320	29,890	2,264	32,154
Neuroscience	31,140	33,670	30,836	2,306	33,142
Developmental Biology	15,869	19,480	15,714	1,190	16,904
Total	77,193	88,470	76,440	5,760	82,200
ENVIRONMENTAL BIOLOGY					
Systematic and Population Biology	21,243	25,670	22,593	1,803	24,396
Ecological Studies	26,336	30,460	25,119	1,803	26,922
Long-term Projects	25,062	30,360	23,968	1,804	25,772
Total	72,641	86,490	71,680	5,410	77,090
BIOLOGICAL INSTRUMENTATION AND RESOURCES					
Instrumentation and Instrument Development	13,973	18,450	13,880	220	14,100
Special Projects	27,410	31,720	27,220	2,650	29,870
Total	41,383	50,170	41,100	2,870	43,970
Total, BIO	$274,350	$320,630	$271,330	$20,133	$291,463

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	REVISED FY 1993 CURRENT PLAN 1/
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
COMPUTER AND COMPUTATION RESEARCH					
Computer and Computation Research	$34,772	$43,040	$34,800	$6,620	$41,420
Total	34,772	43,040	34,800	6,620	41,420
INFORMATION, ROBOTICS AND INTELLIGENT SYSTEMS					
Information, Robotics and Intelligent Systems	26,903	36,830	26,950	8,890	35,840
Total	26,903	36,830	26,950	8,890	35,840
MICROELECTRONIC INFORMATION PROCESSING SYSTEMS					
Microelectronic, Information Processing Systems	21,443	30,440	21,490	6,710	28,200
Total	21,443	30,440	21,490	6,710	28,200
ADVANCED SCIENTIFIC COMPUTING					
Centers	65,840	75,810	65,940	8,213	74,153
New Technologies	3,590	10,900	3,590	4,510	8,100
Total	69,430	86,710	69,530	12,723	82,253
NETWORKING AND COMMUNICATIONS RESEARCH AND INFRASTRUCTURE					
NSFNET	25,619	37,090	30,160	6,930	37,090
Networking and Communications Research	9,763	11,000	9,800	1,200	11,000
Total	35,382	48,090	39,960	8,130	48,090
CROSS-DISCIPLINARY ACTIVITIES					
Cross-Disciplinary Activities	22,445	27,110	22,490	4,620	27,110
Total	22,445	27,110	22,490	4,620	27,110
Total, CISE	$210,375	$272,220	$215,220	$47,693	$262,913

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	FY 1993 REVISED CURRENT PLAN 1/
ENGINEERING					
BIOLOGICAL AND CRITICAL SYSTEMS					
Bioengineering and Aiding the Disabled	$14,053	$18,210	$14,434	$2,009	$16,443
Environmental and Ocean Systems	6,242	7,400	5,862	724	6,586
Earthquake Hazard Mitigation	16,252	17,600	13,900	2,663	16,563
Natural and Man-Made Hazard Mitigation	2,831	2,810	2,424	464	2,888
Total	39,378	46,020	36,620	5,860	42,480
CHEMICAL AND THERMAL SYSTEMS					
Chemical Reaction Processes	9,196	10,880	9,153	1,130	10,283
Interfacial, Transport and Separations Processes	9,114	11,400	8,724	1,120	9,844
Fluid, Particulate and Hydraulic Systems	9,793	11,390	8,842	1,230	10,072
Thermal Systems	8,196	9,890	7,751	1,220	8,971
Total	36,299	43,560	34,470	4,700	39,170
DESIGN AND MANUFACTURING SYSTEMS					
Operations Research and Production Systems	5,862	8,000	6,870	675	7,545
Design and Integration Engineering	5,806	7,900	6,820	675	7,495
Manufacturing Processes and Equipment	10,851	15,160	12,870	1,650	14,520
Total	22,519	31,060	26,560	3,000	29,560
ELECTRICAL AND COMMUNICATIONS SYSTEMS					
Quantum Electronics, Waves and Beams	9,175	11,900	9,450	1,300	10,750
Solid State and Microstructures	10,465	13,600	10,200	1,300	11,500
Communications and Computational Systems	6,030	8,200	5,150	430	5,580
Engineering Systems	7,878	8,400	8,220	1,270	9,490
Emerging Technologies Initiation	1,575	1,880	1,100	0	1,100
	35,123	43,980	34,120	4,300	38,420
ENGINEERING EDUCATION AND CENTERS					
Engineering Education	11,935	18,490	15,400	0	15,400
Human Resources Development	9,292	9,650	11,440	1,000	12,440
Engineering Research Centers	47,498	53,220	47,500	2,500	50,000
Industry/University Cooperative Research Centers	6,697	7,200	6,700	2,500	9,200
Total	75,422	88,560	81,040	6,000	87,040
INDUSTRIAL INNOVATION INTERFACE					
Small Business Innovation Research	22,868	27,790	22,990	7,500	30,490
Management of Technological Innovation	0	1,000	500	500	1,000
Special Studies and Assessments	1,289	1,200	1,200	230	1,430
Total	24,157	29,990	24,690	8,230	32,920
MECHANICAL AND STRUCTURAL SYSTEMS					
Dynamic Systems and Control	4,291	4,620	3,620	580	4,200
Structures, Geomechanics and Building Systems	8,975	9,730	8,680	1,440	10,120
Surface Engineering and Tribology	2,518	3,150	2,550	460	3,010
Mechanics and Materials	9,422	11,850	8,750	1,160	9,910
Total	25,206	29,350	23,600	3,640	27,240
Total, ENG	$258,104	$312,520	$261,100	$35,730	$296,830

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	FY 1993 REVISED CURRENT PLAN 1/
GEOSCIENCES					
ATMOSPHERIC SCIENCES					
Atmospheric Sciences Project Support	$68,530	$79,320	$69,450	$9,150	$78,600
National Center for Atmospheric Research	51,403	64,720	50,200	5,540	55,740
Upper Atmospheric Facilities	6,567	7,890	6,680	602	7,282
Total	126,500	151,930	126,330	15,292	141,622
EARTH SCIENCES					
Earth Sciences Project Support	49,645	57,310	50,000	5,050	55,050
Instrumentation and Facilities	19,541	22,620	19,290	1,680	20,970
Continental Dynamics	6,711	6,210	6,460	702	7,162
Total	75,897	86,140	75,750	7,432	83,182
OCEAN SCIENCES					
Ocean Sciences Research Support	90,036	109,240	93,330	14,850	108,180
Oceanographic Centers and Facilities	51,221	59,320	48,120	2,140	50,260
Ocean Drilling Program	36,247	37,800	36,250	1,550	37,800
Total	177,504	206,360	177,700	18,540	196,240
SCIENCE AND TECHNOLOGY CENTERS					
Science and Technology Centers 2/	932	0	0	0	0
Total	932	0	0	0	0
Total, GEO 3/	$380,833	$446,430	$379,780	$41,284	$421,044

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

2/ Science and Technology Centers incorporated into U.S. Antarctic Research Program begining in FY 1993

3/ Excludes Arctic Research Program, which is reported separately in R&RA.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	FY 1993 REVISED CURRENT PLAN 1/
MATHEMATICAL AND PHYSICAL SCIENCES					
MATHEMATICAL SCIENCES					
Research Project Support	$64,031	$68,710	$62,400	$3,620	$66,020
Special Projects	14,390	16,240	15,190	880	16,070
Total	78,421	84,950	77,590	4,500	82,090
ASTRONOMICAL SCIENCES					
Research Project Support	37,961	41,640	36,100	3,180	39,280
National Centers	74,260	78,360	67,270	4,090	71,360
Total	112,221	120,000	103,370	7,270	110,640
PHYSICS					
Research Project Support	102,291	108,770	94,480	9,670	104,150
Facilities	35,780	39,800	33,750	0	33,750
Total	138,071	148,570	128,230	9,670	137,900
CHEMISTRY					
Research Project Support	95,490	104,480	93,630	9,730	105,360
Instrumentation & Infrastructure	16,620	21,470	18,590	300	16,890
Total	112,110	125,950	112,220	10,030	122,250
MATERIALS RESEARCH					
Materials Research Project Support	77,730	96,350	82,820	4,890	87,710
Materials Research Centers and Groups	48,070	51,440	49,450	3,490	52,940
National Facilities and Instrumentation	17,740	19,700	18,400	500	18,900
Total	143,540	167,490	150,670	8,880	159,550
MAJOR RESEARCH EQUIPMENT					
Major Research Equipment	37,970	79,000	47,860	140	48,000
Total	37,970	79,000	47,860	140	48,000
Total, MPS	$622,333	$725,960	$619,940	$40,490	$660,430

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	FY 1993 REVISED CURRENT PLAN 1/
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES					
SOCIAL, BEHAVIORAL AND ECONOMIC RESEARCH					
Economic, Decision and Management Sciences	$21,482	$25,960	$20,850	$1,460	$22,310
Social and Political Sciences	14,563	18,350	15,141	1,000	16,141
Anthropological and Geographic Sciences	13,496	15,030	12,975	1,050	14,025
Cognitive, Psychological and Language Sciences	12,751	14,640	12,262	1,000	13,262
Science, Technology and Society	3,699	4,380	4,212	400	4,612
Total	65,991	78,360	65,440	4,910	70,350
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES					
International Coopertive Scientific Activities	13,109	14,900	12,410	3,510	15,920
Total	13,109	14,900	12,410	3,510	15,920
SCIENCE RESOURCES STUDIES					
Studies of Science and Engineering Resources	8,867	14,530	11,680	1,000	12,680
Total	8,867	14,530	11,680	1,000	12,680
Total, SBE	$87,967	$107,790	$89,530	$9,420	$98,950
ARCTIC RESEARCH PROGRAM 2/					
Arctic Research Projects	20,597	25,390	21,570	2,500	24,070
Arctic Research Commission	531	560	530	0	530
Total	$21,128	$25,950	$22,100	$2,500	$24,600
EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH 3/	$18,025	$0	$0	$0	$0
Subtotal, RESEARCH AND RELATED ACTIVITIES	$1,871,135	$2,211,500	$1,859,000	$187,230	$2,056,230
Carryover	0	0	2,969	0	2,969
Total, RESEARCH AND RELATED ACTIVITIES	$1,871,135	$2,211,500	$1,861,969	$187,230	$2,059,219

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carrycver.

2/ Arctic Research Program reported in U.S. Polar Research Programs Appropriation begining in FY 1994.

3/ EPSCoR reported in Education and Human Resources Appropriation begining in FY 1993.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	FY 1993 REVISED CURRENT PLAN 1/
EDUCATION AND HUMAN RESOURCES					
SYSTEMIC REFORM					
Educational System Reform	$44,493	$56,500	$61,260	$0	$61,260
Experimental Program to Stimulate Competitive Research (EPSCoR) 2/	0	19,500	24,420	0	24,420
Total	44,493	76,000	85,680	0	85,680
ELEMENTARY, SECONDARY AND INFORMAL EDUCATION					
Student Support	10,929	11,000	10,950	0	10,950
Curriculum Development	41,040	39,850	39,680	0	39,680
Teacher Enhancement and Development	111,656	105,500	102,970	0	102,970
Informal Science Education	34,498	35,000	34,850	0	34,850
Total	198,123	191,350	188,450	0	188,450
UNDERGRADUATE EDUCATION					
Curriculum and Laboratory Development	40,814	41,000	40,830	0	40,830
Teacher and Faculty Development	19,850	22,000	20,910	0	20,910
Total	60,664	63,000	61,740	0	61,740
GRADUATE EDUCATION AND RESEARCH DEVELOPMENT					
Graduate Student Support	50,222	50,000	54,790	0	54,790
Faculty Development	5,375	7,900	7,670	0	7,670
Total	55,597	57,900	62,460	0	62,460
HUMAN RESOURCE DEVELOPMENT					
Precollege Education	15,198	13,890	13,830	0	13,830
Undergraduate Student Support	16,524	20,100	19,010	0	19,010
Institutional Support	12,893	13,000	12,950	0	12,950
Model and Experimental Programs	1,663	3,110	3,100	0	3,100
Total	46,278	50,100	48,890	0	48,890
RESEARCH, EVALUATION AND DISSEMINATION					
Research	14,036	15,250	14,790	0	14,790
Evaluation	5,632	6,000	5,970	0	5,970
Dissemination and Technology Utilization	18,593	19,900	19,520	0	19,520
Total	38,261	41,150	40,280	0	40,280
Subtotal, EHR Appropriation	441,416	479,500	487,500	0	487,500
Carryover	0	23,000	24,074	0	24,074
Total, EHR	$441,416	$502,500	$511,574	$0	$511,574

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

2/ EPSCoR is reported in R&RA in FY 1992.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 CURRENT PLAN	FY 1993 STIMULUS PACKAGE	FY 1993 REVISED CURRENT PLAN 1/
UNITED STATES POLAR RESEARCH PROGRAMS	$77,371	$93,000	$158,000	$0	$158,000
Carryover	0	0	964	0	964
Total	$77,371	$93,000	$158,964	$0	$158,964
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$10,000	$70,000	$63,360	$0	$63,360
Carryover	0	0	69	0	69
Total	$10,000	$70,000	$63,429	$0	$63,429
ACADEMIC RESEARCH FACILITIES AND INSTRUMENTATION	$33,356	$33,000	$50,000	$4,696	$54,696
Carryover	0	0	374	0	374
Total	$33,356	$33,000	$50,374	$4,696	$55,070
CRITICAL TECHNOLOGIES INSTITUTE	$0	$1,000	$1,000	$0	$1,000
SALARIES AND EXPENSES	$109,993	$135,000	$111,000	$4,696	$115,696
NSF HEADQUARTERS RELOCATION	$0	$0	$0	$0	$0
OFFICE OF INSPECTOR GENERAL	$3,857	$4,000	$3,688	$0	$3,688
Subtotal, NATIONAL SCIENCE FOUNDATION	$2,547,128	$3,027,000	$2,733,548	$206,622	$2,940,170
Carryover	0	23,000	28,470	0	28,470
TOTAL, NATIONAL SCIENCE FOUNDATION	$2,547,128	$3,050,000	$2,762,018	$206,622	$2,968,640

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

SUMMARY OF FY 1994 BUDGET BY APPROPRIATION AND ACTIVITY

TOTAL FY 1994

(Dollars In Thousands)

	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED ESTIMATE	FY 1994 ESTIMATE	DIFFERENCE
RESEARCH AND RELATED ACTIVITIES					
Biological Sciences	$274,350	$320,630	$291,609	$311,910	$20,301
Computer and Information Science and Engineering	$210,375	$272,220	$263,059	$296,010	$32,951
Engineering	$258,104	$312,520	$296,976	$323,050	$26,074
Experimental Program To Stimulate Competitive Research	$18,025	$0	$0	$0	$0
Geosciences	$401,961	$472,380	$447,649	$448,530	$881
Arctic Research Program 1/	[$21,128]	[$25,950]	[$24,600]	$0	–
Mathematical and Physical Sciences	$622,333	$725,960	$660,576	$718,390	$57,814
Social, Behavioral, and Economic Sciences	$85,987	$107,790	$99,350	$106,910	$7,560
Subtotal	$1,871,135	$2,211,500	$2,059,219	$2,204,800	$145,581
Unobligated Balance Available Start of Year	($1,822)	$0	($2,989)	$0	$2,989
Unobligated Balance Available End of Year	$2,989	$0	$0	$0	$0
Adjustments to Prior Year Accounts	($875)	$0	$0	$0	$0
Unobligated Balance Lapsing	$573	$0	$0	$0	$0
Research and Related Activities Appropriation	$1,872,000	$2,211,500	$2,056,230	$2,204,800	$148,570
EDUCATION AND HUMAN RESOURCES ACTIVITIES					
Systemic Reform	$44,493	$76,000	$85,680	$102,980	$17,300
Elementary and Secondary Education	$198,123	$191,350	$188,450	$197,950	$9,500
Undergraduate Education	$60,664	$63,000	$62,014	$74,840	$12,826
Graduate Education and Research Develop.	$55,597	$57,900	$85,260	$66,460	($18,800)
Human Resource Development	$46,278	$50,100	$49,190	$65,890	$16,700
Research, Evaluation and Dissemination	$36,261	$41,150	$40,980	$47,980	$7,000
Subtotal	$441,416	$479,500	$511,574	$556,100	$44,526
Unobligated Balance Available Start of Year	($490)	$0	($24,074)	$0	$24,074
Unobligated Balance Available End of Year	$24,074	$23,000	$0	$0	$0
Adjustments to Prior Year Accounts	($112)	$0	$0	$0	$0
Unobligated Balance Lapsing	$112	$0	$0	$0	$0
Education and Human Resources Activities Appropriation	$465,000	$502,500	$487,500	$556,100	$68,600
UNITED STATES POLAR RESEARCH PROGRAMS					
U.S. Arctic Research Activities	$0	$0	$0	$26,200	$26,200
U.S. Antarctic Research Activities	$22,000	$26,740	$26,700	$28,480	$1,780
Operations and Science Support	$55,371	$66,260	$132,264	$108,420	($23,844)
Subtotal	$77,371	$93,000	$158,964	$163,100	$4,136
Unobligated Balance Available Start of Year	($321)	$0	($964)	$0	$964
Unobligated Balance Available End of Year	$964	$0	$0	$0	$0
Adjustments to Prior Year Accounts	($14)	$0	$0	$0	$0
U.S. Polar Research Programs Appropriation	$78,000	$93,000	$158,000	$163,100	$5,100

SUMMARY OF FY 1994 BUDGET BY APPROPRIATION AND ACTIVITY

TOTAL FY 1994

(Dollars in Thousands)

	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED ESTIMATE	FY 1994 ESTIMATE	DIFFERENCE
UNITED STATES ANTARCTIC LOGISTICAL ACTIVITIES	$10,000	$70,000	$63,429	$65,100	$1,740
Unobligated Balance Available Start of Year	($69)	$0	($69)	$0	$0
Unobligated Balance Available End of Year	$69	$0	$0	$0	$0
U.S. Antarctic Logistical Activities Appropriation	$10,000	$70,000	$63,360	$65,100	$1,740
ACADEMIC RESEARCH FACILITIES AND INSTRUMENTATION	$33,356	$33,000	$55,070	$55,000	($70)
Unobligated Balance Available Start of Year	($739)	$0	($374)	$0	$374
Unobligated Balance Available End of Year	$374	$0	$0	$0	$0
Adjustments to Prior Year Accounts	$0	$0	$0	$0	$0
Unobligated Balance Lapsing	$9	$0	$0	$0	$0
Academic Research Facilities and Instrumentation Appropriation	$33,000	$33,000	$54,696	$55,000	$304
CRITICAL TECHNOLOGIES INSTITUTE	$0	$1,000	$1,000	$1,000	$0
SALARIES AND EXPENSES	$112,565	$135,000	$115,696	$125,800	$10,104
Unobligated Balance Available Start of Year	($70)	$0	$0	$0	$0
Unobligated Balance Available End of Year	$0	$0	$0	$0	$0
Adjustments to Prior Year Accounts	($1,339)	$0	$0	$0	$0
Unobligated Balance Lapsing	$416	$0	$0	$0	$0
Transferred from Other Accounts	($2,208)	$0	$0	$0	$0
Spending Authority from Offsetting Collections	($364)	$0	$0	$0	$0
Salaries and Expenses Appropriation 2/	$109,000	$135,000	$115,696	$125,800	$10,104
NSF HEADQUARTERS RELOCATION	$0	$0	$0	$5,200	$5,200
OFFICE OF INSPECTOR GENERAL	$3,857	$4,000	$3,688	$4,100	$412
Unobligated Balance Available Start of Year	($397)	$0	$0	$0	$0
Unobligated Balance Available End of Year	$0	$0	$0	$0	$0
Adjustments to Prior Year Accounts	($1)	$0	$0	$0	$0
Unobligated Balance Lapsing	$41	$0	$0	$0	$0
Office of Inspector General Appropriation	$3,500	$4,000	$3,688	$4,100	$412
SUBTOTAL, NSF APPROPRIATION	$2,570,500	$3,050,000	$2,940,170	$3,180,200	$234,830
Carryover	$0	$0	$24,074	$0	($24,074)
TOTAL, NATIONAL SCIENCE FOUNDATION	$2,570,500	$3,050,000	$2,964,244	$3,180,200	$215,956

1/ Arctic Research Program numbers are included within the Geosciences total.

2/ FY 1992 Actual and FY 1993 Request exclude GSA reimbursements for NSF Headquarters Relocation.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
BIOLOGICAL SCIENCES					
MOLECULAR AND CELLULAR BIOSCIENCES					
Biochemistry and Molecular Structure and Function	$33,577	$37,960	$35,303	$37,400	$2,097
Cell Biology	19,017	22,080	20,400	21,950	1,550
Genetics and Nucleic Acids	30,539	35,460	32,500	34,760	2,260
Total	83,133	95,500	88,203	94,110	5,907
INTEGRATIVE BIOLOGY AND NEUROSCIENCES					
Physiology and Behavior	30,184	35,320	32,154	34,300	2,146
Neuroscience	31,140	33,670	33,142	35,510	2,368
Developmental Biology	15,869	19,480	16,904	18,190	1,286
Total	77,193	88,470	82,200	88,000	5,800
ENVIRONMENTAL BIOLOGY					
Systematic and Population Biology	21,243	25,670	24,396	25,896	1,500
Ecological Studies	26,336	30,460	26,922	29,422	2,500
Long-term Projects	25,062	30,360	25,772	27,772	2,000
Total	72,641	86,490	77,090	83,090	6,000
BIOLOGICAL INSTRUMENTATION AND RESOURCES					
Instrumentation and Instrument Development	13,973	18,450	14,100	14,850	750
Special Projects	27,410	31,720	29,870	31,860	1,990
Total	41,383	50,170	43,970	46,710	2,740
Total, BIO	$274,350	$320,630	$291,463	$311,910	$20,447

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
COMPUTER AND COMPUTATION RESEARCH					
Computer and Computation Research	$34,772	$43,040	$41,420	$46,070	$4,650
Total	34,772	43,040	41,420	46,070	4,650
INFORMATION, ROBOTICS AND INTELLIGENT SYSTEMS					
Information, Robotics and Intelligent Systems	26,903	36,830	35,840	40,620	4,780
Total	26,903	36,830	35,840	40,620	4,780
MICROELECTRONIC INFORMATION PROCESSING SYSTEMS					
Microelectronic Information Processing Systems	21,443	30,440	28,200	32,830	4,630
Total	21,443	30,440	28,200	32,830	4,630
ADVANCED SCIENTIFIC COMPUTING					
Centers	65,840	75,810	74,153	80,370	6,217
New Technologies	3,590	10,900	8,100	10,900	2,800
Total	69,430	86,710	82,253	91,270	9,017
NETWORKING AND COMMUNICATIONS RESEARCH AND INFRASTRUCTURE					
NSFNET	25,619	37,090	37,090	43,190	6,100
Networking and Communications Research	9,763	11,000	11,000	11,750	750
Total	35,382	48,090	48,090	54,940	6,850
CROSS-DISCIPLINARY ACTIVITIES					
Cross-Disciplinary Activities	22,445	27,110	27,110	30,280	3,170
Total	22,445	27,110	27,110	30,280	3,170
Total, CISE	$210,375	$272,220	$262,913	$296,010	$33,097

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
ENGINEERING					
BIOLOGICAL AND CRITICAL SYSTEMS					
Bioengineering and Aiding the Disabled	$14,053	$18,210	$16,443	$18,154	$1,711
Environmental and Ocean Systems	6,242	7,400	6,586	6,590	4
Earthquake Hazard Mitigation	16,252	17,600	16,563	17,482	919
Natural and Man-Made Hazard Mitigation	2,831	2,810	2,888	3,194	306
Total	39,378	46,020	42,480	45,420	2,940
CHEMICAL AND THERMAL SYSTEMS					
Chemical Reaction Processes	9,196	10,880	10,283	11,393	1,110
Interfacial, Transport and Separations Processes	9,114	11,400	9,844	10,254	410
Fluid, Particulate and Hydraulic Systems	9,793	11,390	10,072	10,782	710
Thermal Systems	8,196	9,890	8,971	9,841	870
Total	36,299	43,560	39,170	42,270	3,100
DESIGN AND MANUFACTURING SYSTEMS					
Operations Research and Production Systems	5,862	8,000	7,545	8,345	800
Design and Integration Engineering	5,806	7,900	7,495	8,295	800
Manufacturing Processess and Equipment	10,851	15,160	14,520	16,160	1,640
Total	22,519	31,060	29,560	32,800	3,240
ELECTRICAL AND COMMUNICATIONS SYSTEMS					
Quantum Electronics, Waves and Beams	9,175	11,900	10,750	11,714	964
Solid State and Microstructures	10,465	13,800	11,500	12,764	1,264
Communications and Computational Systems	6,030	8,200	5,580	6,837	1,257
Engineering Systems	7,878	8,400	9,490	10,405	915
Emerging Technologies Initiation	1,575	1,680	1,100	1,100	0
Total	35,123	43,980	38,420	42,820	4,400
ENGINEERING EDUCATION AND CENTERS					
Engineering Education	11,935	18,490	15,400	18,400	3,000
Human Resources Development	9,292	9,650	12,440	12,610	170
Engineering Reseaarch Centers	47,498	53,220	50,000	52,500	2,500
Industry/University Cooperativa Research Centers	6,697	7,200	9,200	9,200	0
Total	75,422	88,560	87,040	92,710	5,670
INDUSTRIAL INNOVATION INTERFACE					
Small Business Innovation Research	22,868	27,790	30,490	33,120	2,630
Management of Technological Innovation	0	1,000	1,000	1,300	300
Special Studies and Assessments	1,289	1,200	1,430	1,470	40
Industry/University Cooperative Projects	0	0	0	1,000	1,000
Total	24,157	29,990	32,920	36,890	3,970
MECHANICAL AND STRUCTURAL SYSTEMS					
Dynamic Systems and Control	4,291	4,620	4,200	4,867	667
Structures, Geomechanics and Building Systems	8,975	9,730	10,120	10,954	834
Surface Engineering and Tribology	2,518	3,150	3,010	3,366	356
Mechanics and Materials	9,422	11,850	9,910	10,953	1,043
Total	25,206	29,350	27,240	30,140	2,900
Total, ENG	$258,104	$312,520	$296,830	$323,050	$26,220

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
GEOSCIENCES					
ATMOSPHERIC SCIENCES					
Atmospheric Sciences Project Support	$68,530	$79,320	$78,600	$81,930	$3,330
National Center for Atmospheric Research	51,403	64,720	55,740	59,240	3,500
Upper Atmospheric Facilities	6,567	7,890	7,282	7,930	648
Total	126,500	151,930	141,622	149,100	7,478
EARTH SCIENCES					
Earth Sciences Project Support	49,645	57,310	55,050	57,270	2,220
Instrumentation and Facilities	19,541	22,620	20,970	24,920	3,950
Continental Dynamics	6,711	8,210	7,162	7,460	298
Total	75,897	88,140	83,182	89,650	6,468
OCEAN SCIENCES					
Ocean Sciences Research Support	90,036	109,240	108,180	112,570	4,390
Oceanographic Centers and Facilities	51,221	59,320	50,260	56,760	6,500
Ocean Drilling Program	36,247	37,800	37,800	40,450	2,650
Total	177,504	206,360	196,240	209,780	13,540
SCIENCE AND TECHNOLOGY CENTERS					
Science and Technology Centers 2/	932	0	0	0	0
Total	932	0	0	0	0
Total, GEO 3/	$380,833	$446,430	$421,044	$448,530	$27,486

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

2/ Science and Technology Centers incorporated into U.S. Antarctic Research Program begining in FY 1993

3/ Excludes Arctic Research Program, which is reported separately in R&RA.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
MATHEMATICAL AND PHYSICAL SCIENCES					
MATHEMATICAL SCIENCES					
Research Project Support	$64,031	$68,710	$66,020	$69,940	$3,920
Special Projects	14,390	16,240	16,070	18,070	2,000
Total	78,421	84,950	82,090	88,010	5,920
ASTRONOMICAL SCIENCES					
Research Project Support	37,961	41,640	39,280	40,780	1,500
National Centers	74,260	78,360	71,360	73,160	1,800
Total	112,221	120,000	110,640	113,940	3,300
PHYSICS					
Research Project Support	102,291	108,770	104,150	106,850	2,700
Facilities	35,780	39,800	33,750	35,750	2,000
Total	138,071	148,570	137,900	142,600	4,700
CHEMISTRY					
Research Project Support	95,490	104,480	105,360	111,500	6,140
Instrumentation & Infrastructure	16,620	21,470	16,890	19,390	2,500
Total	112,110	125,950	122,250	130,890	8,640
MATERIALS RESEARCH					
Materials Research Project Support	77,730	96,350	87,710	92,410	4,700
Materials Research Centers and Groups	48,070	51,440	52,940	56,440	3,500
National Facilities and Instrumentation	17,740	19,700	18,900	22,100	3,200
Total	143,540	167,490	159,550	170,950	11,400
MAJOR RESEARCH EQUIPMENT					
Major Research Equipment	37,970	79,000	48,000	72,000	24,000
Total	37,970	79,000	48,000	72,000	24,000
Total, MPS	$622,333	$725,960	$660,430	$718,390	$57,960

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES					
SOCIAL, BEHAVIORAL AND ECONOMIC RESEARCH					
Economic, Decision and Management Sciences	$21,482	$25,980	$22,310	$23,720	$1,410
Social and Political Sciences	14,563	18,350	16,141	17,340	1,199
Anthropological and Geographic Sciences	13,496	15,030	14,025	14,730	705
Cognitive, Psychological and Language Sciences	12,751	14,640	13,262	14,660	1,398
Science, Technology and Society	3,699	4,360	4,612	4,860	248
Total	65,991	78,360	70,350	75,310	4,960
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES					
International Coopertive Scientific Activities	13,109	14,900	15,920	18,920	3,000
Total	13,109	14,900	15,920	18,920	3,000
SCIENCE RESOURCES STUDIES					
Studies of Science and Engineering Resources	8,887	14,530	12,680	12,680	0
Total	6,887	14,530	12,680	12,680	0
Total, SBE	$85,987	$107,790	$98,950	$106,910	$7,960
ARCTIC RESEARCH PROGRAM 2/					
Arctic Research Projects	20,597	25,390	24,070	0	0
Arctic Research Commission	531	560	530	0	0
Total	$21,128	$25,950	$24,600	$0	$0
EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH 3/	$18,025	$0	$0	$0	$0
Subtotal, RESEARCH AND RELATED ACTIVITIES	$1,871,135	$2,211,500	$2,056,230	$2,204,800	$148,570
Carryover	0	0	2,989	0	(2,989)
Total, RESEARCH AND RELATED ACTIVITIES	$1,871,135	$2,211,500	$2,059,219	$2,204,800	$145,581

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

2/ Arctic Research Program reported in U.S. Polar Research Programs Appropriation begining in FY 1994.

3/ EPSCoR reported in Education and Human Resources Appropriation begining in FY 1993.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
EDUCATION AND HUMAN RESOURCES					
SYSTEMIC REFORM					
Educational System Reform	$44,493	$56,500	$61,260	$78,560	$17,300
Experimental Program to Stimulate Competitive Research (EPSCoR) 2/	0	19,500	24,420	24,420	0
Total	44,493	76,000	85,680	102,980	17,300
ELEMENTARY, SECONDARY AND INFORMAL EDUCATION					
Student Support	10,929	11,000	10,950	11,000	50
Curriculum Development	41,040	39,850	39,680	45,450	5,770
Teacher Enhancement and Development	111,656	105,500	102,970	106,500	3,530
Informal Science Education	34,498	35,000	34,850	35,000	150
Total	198,123	191,350	188,450	197,950	9,500
UNDERGRADUATE EDUCATION					
Curriculum and Laboratory Development	40,814	41,000	40,830	48,430	7,600
Teacher and Faculty Development	19,850	22,000	20,910	26,410	5,500
Total	60,664	63,000	61,740	74,840	13,100
GRADUATE EDUCATION AND RESEARCH DEVELOPMENT					
Graduate Student Support	50,222	50,000	54,790	58,790	4,000
Faculty Development	5,375	7,900	7,670	7,670	0
Total	55,597	57,900	62,460	66,460	4,000
HUMAN RESOURCE DEVELOPMENT					
Precollege Education	15,196	13,890	13,830	13,830	0
Undergraduate Student Support	16,524	20,100	19,010	26,010	7,000
Institutional Support	12,695	13,000	12,950	15,450	2,500
Model and Experimental Programs	1,863	3,110	3,100	10,600	7,500
Total	46,278	50,100	48,890	65,890	17,000
RESEARCH, EVALUATION AND OISSEMINATION					
Research	14,036	15,250	14,790	14,790	0
Evaluation	5,632	6,000	5,970	8,970	3,000
Dissemination and Technology Utilization	16,593	19,900	19,520	24,220	4,700
Total	36,261	41,150	40,280	47,980	7,700
Subtotal, EHR Appropriation	441,416	479,500	487,500	556,100	68,600
Carryover		23,000	24,074		(24,074)
Total, EHR	$441,416	$502,500	$511,574	$556,100	$44,526

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

2/ EPSCoR is reported in R&RA in FY 1992.

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1992 ACTUAL	FY 1993 REQUEST	FY 1993 REVISED CURRENT PLAN 1/	FY 1994 REQUEST	DIFFERENCE
UNITED STATES POLAR RESEARCH PROGRAMS	$77,371	$93,000	$158,000	$163,100	$5,100
Carryover	0	0	964	0	(964)
Total	$77,371	$93,000	$158,964	$163,100	$4,136
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$10,000	$70,000	$63,360	$65,100	$1,740
Carryover	0	0	69	0	(69)
Total	$10,000	$70,000	$63,429	$65,100	$1,671
ACADEMIC RESEARCH FACILITIES AND INSTRUMENTATION	$33,356	$33,000	$54,696	$55,000	$304
Carryover	0	0	374	0	(374)
Total	$33,356	$33,000	$55,070	$55,000	($70)
CRITICAL TECHNOLOGIES INSTITUTE	$0	$1,000	$1,000	$1,000	$0
SALARIES AND EXPENSES	$109,993	$135,000	$115,696	$125,800	$10,104
NSF HEADQUARTERS RELOCATION	$0	$0	$0	$5,200	$5,200
OFFICE OF INSPECTOR GENERAL	$3,857	$4,000	$3,688	$4,100	$412
Subtotal, NATIONAL SCIENCE FOUNDATION	$2,547,128	$3,027,000	$2,940,170	$3,180,200	$240,030
Carryover	0	23,000	28,470	0	(28,470)
TOTAL, NATIONAL SCIENCE FOUNDATION	$2,547,128	$3,050,000	$2,968,640	$3,180,200	$211,560

1/ Revised Current Plan amounts exclude carryover unobligated balances from 1992. See explanation of 1992 carryover.

EXPLANATION OF CARRYOVER 1992

The Foundation's unobligated balances of $28.511 million from the FY92 Appropriation consist of:

- $24.074 million from the FY92 Education and Human Resources Activities Appropriation; funds will be obligated in FY93 as follows: $22.8 million for the Graduate Education and Research Development subactivity to fund Graduate Research Traineeships awards, which were deferred until FY93; $274 thousand for the Undergraduate Education subactivity to address underrepresentation and precollege teacher preparation; $300 thousand for the Human Resource Development subactivity to support projects to women and persons with disabilities; and $700 thousand for the Research, Evaluation and Dissemination subactivity for high performance computing and communication awards.

- $2.989 million from the FY92 Research and Related Activities Appropriation funds will be obligated in FY93 to support activities for which these funds were intended in FY92. The amounts to be used by each research directorate are displayed in the table below.

- $964 thousand from the FY92 U.S. Polar Research Programs account will be obligated in FY93 for support of South Pole Facility Upgrades and $64 thousand from the U.S. Antarctic Logistical Activities account will be obligated for Navy logistical support.

Crosswalk from Current Plan to FY 1993 Estimates
(000)

	FY 1993 Current Plan New Obligation Authority	FY 1993 Carryover from FY 1992	FY 1993 Estimate
Biological Sciences	$291,463	146	291,609
Computer and Information Science and Engineering	262,913	146	263,059
Engineering	296,830	146	296,976
Geosciences	421,044	2,005	423,049
Mathematical and Physical Sciences	660,430	146	660,576
Social, Behavioral and Economic Sciences	98,950	400	99,350
Arctic Research Program	24,600	0	24,600
Research & Related Activities subtotal	$2,056,230	2,989	$2,059,219
U. S. Polar Programs	158,000	964	158,964
U.S. Antarctic Logistical	63,360	69	63,429
Salaries and Expenses	115,696	0	115,696
Office of Inspector General	3,688	0	3,688
Education and Human Resources	487,500	24,074	511,574
Critical Technologies Institute	1,000	0	1,000
Academic Research Facilities and Instrumentation	54,696	374	55,070
Total	$2,940,170	$28,470	$2,968,640

FY 94 APPROPRIATION LANGUAGE

National Science Foundation

RESEARCH AND RELATED ACTIVITIES

For necessary expenses in carrying out the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), and the Act to establish a National Medal of Science (42 U.S.C. 1880-1881); services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of aircraft; [$1,859,000,000] $1,834,300,000 to remain available until September 30, [1994] 1995: Provided, That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation: [Provided further, That notwithstanding section 104 of the National Science Foundation Authorization Act of 1988 (Public Law 100-570), no funds appropriated to the National Science Foundation under this Act may be transferred among appropriations accounts:] Provided further, That to the extent that the amount appropriated is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally: [Provided further, That no funds in this Act or any other Act shall be used to lease or purchase an arctic research vessel built by a shipyard located in a foreign country if such a vessel of United States origin can be obtained at a cost no more than 50 per centum above that of the least expensive technically acceptable foreign vessel bid: Provided further, That in determining the cost of such a vessel, such cost shall be increased by the amount of any subsidies or financing provided by a foreign government (or instrumentality thereof) to such a vessel's construction: Provided further: That the vessel contracted for pursuant to the foregoing shall be of United States Registry.] (Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriation Act, 1994).

FY 1994 Investment: In addition to amounts otherwise available under this heading and subject to the same terms and conditions, $370,500,000.

EDUCATION AND HUMAN RESOURCES ACTIVITIES

For necessary expenses in carrying out science and engineering education and human resources programs and activities pursuant to the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109 and rental of conference rooms in the District of Columbia, [$487,000,000] $499,400,000 to remain available until September 30, [1994] 1995: Provided: That to the extent that the amount of this appropriation is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally. (Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994).

FY 1994 Investment: In addition to amounts otherwise available under this heading and subject to the same terms and conditions, $56,700,000.

UNITED STATES [ANTARCTIC] POLAR RESEARCH [ACTIVITIES] PROGRAMS

For necessary expenses in carrying out arctic and antarctic [the] research and operational support for and for reimbursement to other Federal agencies for [logistical] operational and science support and other related activities forthe United States Antarctic Program and the Arctic Research Program pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1865); maintenance and operation of aircraft and purchase of flight services for research and operations support; improvement of environmental practices and enhancements of safety; services as authorized by 5 U.S.C. 3109; maintenance and operations of research ships for research and operations support; hire of passenger motor vehicles; not to exceed $2,500 for official reception and representation expenses; [$158,000,000] $163,100,000 to remain avtil expended: Provided, That receipts for support services and materials provided for non-Federal activities may be credited to this appropriation.[Provided further, That no funds in this account shall be used for the purchase of aircraft other than ones transferred from other Federal agencies.] (Department of Veterans Affairs and Housing and Urban Development, and Independent Agencies Act of 1994).

UNITED STATES ANTARCTIC LOGISTICAL [SUPPORT] ACTIVITIES

For necessary expenses in reimbursing Federal agencies for logistical and other related activities for the United States Antarctic Program pursuant to the National Science Foundation Act of 1950 (4 U.S.C. 1861-1875); acquisition, maintenance, and operation of aircraft for research operations support; improvement of environmental practices and enhancements of safety; [$63,360,000] $65,100,000 to remain available until expended: Provided, That receipts for support services and materials provided for non-Federal activities may be credited to this appropriation: (Department of Veterans and Housing and Urban Development, and Independent Agencies Appropriations Act of 1994).

ACADEMIC RESEARCH FACILITIES AND INSTRUMENTATION

For necessary expenses in carrying out an academic research facilities and instrumentation program pursuant to the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services authorized by 5 U.S.C. 3109 and rental of conference rooms in the District of Columbia, [$50,000,000] $55,000,000 to remain available until September 30, [1994] 1995.(Department of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations Act, 1994).

SALARIES AND EXPENSES

For necessary salaries and expenses in carrying out the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875) [, and the Act to establish a National Medal of Science (42 U.S.C. 1880-1881)]; services authorized by 5 U.S.C. 3109; hire of passenger motor vehicles; not to exceed [$6,000] for official reception and representation expenses; uniforms or allowances therefor, as authorized by law (5 U.S.C. 5901-5902); rental of conference rooms in the District of Columbia; reimbursement of the General Service Administration for security and guard services; [$111,000,000] $125,800,000: Provided, That contracts may be entered into under salaries and expenses in fiscal year [1993] 1994 for maintenance and operations of facilities, and for other services, to be provided during the next fiscal year. (Department of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994).

OFFICE OF INSPECTOR GENERAL

For necessary expenses of the Office of Inspector General in carrying out the provisions of the Inspector General Act of 1978, as amended [$3,688,000] $4,100,000 to remain avilable until September 30, 1995. (Department of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994).

NATIONAL SCIENCE FOUNDATION HEADQUARTERS RELOCATION

For necessary support of the relocation of the National Science Foundation, for Fiscal Year 1994, $5,200,000 to remain available until expended. Provided: these funds shall be used to reimburse the General Services Administration for services in support of relocating the National Science Foundation for acquisition of necessary equipment and furniture in support of relocation (Department of Veterans Affairs, Housing and Urban Development and Independent Agencies Appropriations Act, 1994).

CRITICAL TECHNOLOGIES INSTITUTE

For necessary expenses for support of the Critical Technologies Institute as authorized by Section 822 of the National Defense Authorization Act for Fiscal Year 1991, as amended (42 U.S.C. 6686) [$1,000,000] 1,000,000 to remain available until expended.
(Veterans Affairs and Housing and Urban Development and Related Agencies Appropriations Act, 1994).

RESEARCH AND RELATED ACTIVITIES: $2,204,800,000

The Research and Related Activities (R&RA) appropriation funds a broad range of activities focused on strengthening the nation's scientific and engineering research enterprise. Foremost is the support for individuals and groups devoted to disciplinary research in traditional fields as well as in cross-disciplinary fields of strategic national importance. Nearly 65 percent of the total FY 1994 R&RA request is allocated for fundamental and strategic research by individuals and groups. The account is also a major source of support for unique national facilities such as telescopes, research ships, and supercomputers, as well as for instrumentation and equipment, all of which enhance the research capabilities of our scientists and engineers. Financial assistance to national centers in various disciplines encourages the growth of strong partnerships among academia, industry and government. In recognition that the transfer of knowledge is critical to U.S. economic growth, this account supports a number of innovative programs to support science and engineering training at the undergraduate, graduate, and post-doctoral levels.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Arctic Research 1/	$ 21.13	$ 25.95	$ 24.60	$ 0.00	24.60	-100.0
Biological Sciences	274.35	320.63	291.46	311.91	$ 20.45	7.0
Computer and Information Science and Engineering	210.38	272.22	262.91	296.01	33.10	12.6
Engineering	258.11	312.52	296.83	323.05	26.22	8.8
Experimental Program to Stimulate Competitive Research (EPSCoR) 2/	18.02	0.00	0.00	0.00	0.00	0.0
Geosciences	380.83	446.43	421.04	448.53	27.49	6.5
Mathematical and Physical Sciences	622.33	725.96	660.43	718.39	57.96	8.8
Social, Behavioral and Economic Sciences	85.99	107.79	98.95	106.91	7.96	8.0
Total, Research & Related Activities	$1,871.14	$2,211.50	$2,056.22	$2,204.80	$148.58	7.2

1/ Transferred to the U.S. Polar Research Programs (USPRP) account in FY 1994, see (USPRP) Tab for detail.

2/ Transferred to the EHR appropriation in FY 1993; see Education and Human Resources Tab for detail

FY 1994 BUDGET REQUEST

The 1994 Research and Related Activities account increases $148.58 million, or 7.2 percent, over the FY 1993 Revised Current Plan, to a total of $2,204.80 million.

The requested increase for the Research and Related Activities appropriation will be used for research projects that invest in the nation's future through support for the development of the next generation of scientists and engineers. This investment will enable researchers to carry out fundamental and strategic research that generates new scientific and engineering knowledge. Support will be focused on individual investigators and will include research in areas such as civil infrastructure systems, environmental research, and intelligent systems. Support for strategic research and the Federal

Coordinating Council for Science, Engineering, and Technology (FCCSET) initiatives, which include improving our understanding of the climate system, math and science education, materials processing, biotechnology, and advanced manufacturing will be provided. Special attention will be given to the development of applications which use advanced computers and communication networks to solve problems in health care, education, and manufacturing.

(Millions of Dollars)

Initiative	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Advanced Materials & Processing Program . . .	$311.40	$320.90	$9.50
Biotechnology	195.30	205.30	10.00
U.S. Global Change Research Program	141.92	149.00	7.08
High Performance Computing & Communications	252.87	291.96	39.09
Math & Science Education	95.41	112.07	16.66
Advanced Manufacturing	112.70	130.25	17.55

- **Presidential interagency initiatives.** The R&RA contribution to total NSF support of interagency initiatives increases approximately $100.00 million or 9.0 percent over the FY 1993 Revised Current Plan.

- **Investigator-initiated research.** Support of research by individuals and groups will increase by $64.00 million to a total of about $1,410.00 million, or 4.7 percent, over the FY 1993 Revised Current Plan. Increasing average award size and duration will be emphasized to enable researchers to more effectively carry out research projects.

- **Equipment and instrumentation.** Support for equipment necessary for the performance of research will increase approximately $11.3 million to a total of over $190.00 million, or about 6.0 percent.

- **Research facilities.** Funding for construction and operations of facilities will be increased, including the continued construction of the Laser Interferometer Gravitational Wave Observatory ($43.00 million) and the GEMINI 8-meter optical/infrared telescopes ($17.00 million). The National High Magnetic Field Laboratory ($12.00 million) remains on schedule.

- **Education and human resources.** A program for Model Institutions for Excellence (MIE) will be initiated to support minority institutions to serve as models for recruitment, academic enhancement, and retention of underrepresented undergraduates in science, engineering, and mathematics. In FY 1994, R&RA together with the Education and Human Resources Activity, will support approximately 6 awards for up to $2.50 million each per year.

A summary of plans within each Activity follows.

The **Biological Sciences (BIO)** Activity increases by $20.45 million, or 7 percent, over the FY 1993 Revised Current Plan to a total of $311.91 million. The request emphasizes NSF's support for several Federal initiatives. BIO support for FCCSET initiatives and specific research areas includes:

- $6.10 million increase in the Biotechnology initiative to total $119.30 million;

- $6.50 million increase for the environmental research initiative to a total of $70.10 million, including a network of Long Term Ecological Research Sites (LTERS);
- $3.49 million increase to a total of $12.49 million for the High Performance Computing and Communications (HPCC) initiative;
- $1.50 million increase to a total of $10.35 million for Global Change; and
- $1.50 million increase for plant science initiative, including the enhancement of the Arabidopsis genome project.

The **Computer and Information Science and Engineering (CISE)** Activity increases by $33.10 million, or 12.6 percent, over the FY 1993 Revised Current Plan to a total of $296.01 million. CISE will enhance support in the High Performance Computing and Communications and Advanced Manufacturing initiatives, providing support for new generations of enabling technology for high performance computer systems and applications. Also, average award size will be increased to fully enable and expedite research projects.

- $25.24 million increase for HPCC, to a total of $253.87 million;
- $7.25 million increase to a total of $38.65 million for Manufacturing, to increase research on high dependability computer controlled systems; and
- $610,000 increase to a total of $20.11 million for the Advanced Materials and Processing Program (AMPP), for research on modeling and simulation of electronics and optical materials and devices in optoelectronic computing.

The **Engineering (ENG)** Activity increases by $26.22 million, or 8.8 percent, over the FY 1993 Revised Current Plan to a total of $ 323.05 million. The ENG request provides for participation in several broad interagency and NSF-wide FCCSET initiatives in critical technology areas, with emphasis on the support of individual investigators and graduate students.

Highlights of funding increases and specific research areas include:

- $7.50 million increase to a total of $80.40 million, to support the Manufacturing initiative;
- $3.90 million increase to a total of $76.20 million for the AMPP initiative;
- $3.21 million increase to a total of $6.31 million to support the HPCC initiative;
- An increase of $2.63 million to a total of $33.12 million to meet the mandated level for the Small Business Innovation Research (SBIR) Program; and
- $2.50 million increment to a total of $52.50 million for the Engineering Research Centers, to increase the number of centers from 18 to 20. Some of the first class of centers may not be renewed. However, any funds not used for center renewal will be used to fund new centers.

The **Geosciences (GEO)** Activity increases by $27.49 million, or 6.5 percent, over the FY 1993 Revised Current Plan to a total of $448.53 million. GEO's participation in several broad interagency initiatives includes the following:

- $4.58 million increase in U.S. Global Change Research Program activities to total $124.50 million;
- $2.07 million increase for the HPCC initiative; and
- $100,000 for the AMPP initiative.

Major facilities and instrumentation will increase by $14.72 million to provide support in such areas as NCAR operating and management costs; Global Change; and participation in HPCC Grand Challenge activities. Funds will provide for the conversion of a military C-130 aircraft into a research aircraft; acquisition and deployment of digital seismographs and for the initial steps of procurement of an Arctic research vessel.

The **Mathematical and Physical Sciences (MPS)** Activity increases by $57.96 million, or 8.8 percent, over the FY 1993 Revised Current Plan to a total of $718.39 million. The MPS request provides for enhanced participation in several FCCSET initiatives and a commitment to individual investigators to increase average award size and duration. Funding highlights include:

- $4.54 million increase for the AMPP initiative to a total of $206.44 million, for research focused on synthesis and processing; theory, modeling and simulation; and materials characterization;
- $5.08 million increase for HPCC to a total of $14.68 million;
- $8.20 million increase for the Math and Science Education initiative to a total of $30.85 million;
- $5.74 million increase for environmental research to a total of $14.54 million, with an emphasis on environmental chemistry; and
- $24.00 million increment to a total of $72.00 million for continued construction of the NHMFL, GEMINI, and LIGO.

The **Social, Behavioral and Economic Sciences (SBE)** Activity will increase by $7.96 million, or 8.0 percent, over the FY 1993 Revised Current Plan to a total of $106.91 million. This provides increased support for the FCCSET initiatives and for increased award size across all research programs. Funding highlights include:

- $1.10 million increase for the Manufacturing, HPCC, and the Math and Science Education initiatives;
- $1.46 million for the Intelligent Systems initiative, for programs to strengthen the teaching of cognitive skills in mathematics and science; and
- $3.00 million increase to a total of $18.92 million for International programs to support international cooperative research experiences for scientists and engineers.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Arctic Research 1/	$ 25.95	$ 24.60	-1.35
Biological Sciences	320.63	291.46	$ -29.17
Computer & Information Science and Engineering	272.22	262.91	-9.31
Engineering	312.52	296.83	-15.69
Geosciences	446.43	421.04	-25.39
Mathematical & Physical Sciences	725.96	660.43	-65.53
Social, Behavioral & Economic Sciences	107.79	98.95	-8.84
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Total, Research & Related Activities	$2,211.50	$2,056.22	$-155.28

1/ Transferred to the USPRP appropriation in FY 1994.

The FY 1993 Revised Current Plan for the R&RA account is $2056.22 million, $155.28 million or 7.0 percent less than originally requested. The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993 which is described in detail in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The supplement provides funds that contribute to the nation's productivity by generating new scientific and engineering knowledge and contributing to the development of the next generation of scientists and engineers. These funds will be focused on research conducted by single investigators and groups. Funding for interagency initiatives has been maintained at FY 1993 Request levels.

The supplement supports individuals and groups devoted to research with a major focus on the strategic interagency initiatives in which NSF participates. The supplement enabled an increase to FY 1993 request levels in all strategic research areas and permitted the enabling of some disciplinary research through increasing award sizes.

The Revised Current Plan includes funds to continue construction of the Laser Interferometer Gravitational Wave Observatory (LIGO) at $20.00 million. Based on continued satisfactory progress, NSF may reprogram up to an additional $8.00 million in FY 1993, thereby increasing the total to $28.00 million.

Decreases from the FY 1993 Request are across all disciplinary research areas, impacting support for graduate students and instrumentation.

CHANGE IN BUDGET STRUCTURE

The Arctic Research Program in the Geosciences Activity is moved to the U.S. Polar Research Programs (USPRP) account to facilitate program management which will be coordinated under the office of the Director to enable higher visibility of the program's activities within NSF. Further discussion can be found under the US Polar Programs section.

BIOLOGICAL SCIENCES: $311,910,000

The Biological Sciences Activity (BIO) supports research in molecular and cellular biosciences, integrative biology and neurosciences, and environmental biology. The BIO Activity provides the context to enable forefront research by investing in the infrastructure of biology: support of people, equipment and centers, ecological research sites and research training groups. The Foundation is the nation's principal supporter of basic academic research in biodiversity, environmental biology and plant biology, providing over 95%, 75%, and 50% of the support in these areas, respectively.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Molecular and Cellular Biosciences	$83.13	$95.50	$88.20	$94.11	$ 5.91	6.7
Integrative Biology and Neuroscience	77.19	88.47	82.20	88.00	5.80	7.1
Environmental Biology	72.64	86.49	77.09	83.09	6.00	7.8
Biological Instrumentation and Resources .	41.38	50.17	43.97	46.71	2.74	6.2
Total, Activity	$274.35	$320.63	$291.46	$311.91	$20.45	7.0

FY 1994 BUDGET REQUEST

The BIO Activity increases by $ 20.45 million over the FY 1993 Revised Current Plan, to a total of $311.91 million. This request for enhanced investment in the Biological Sciences (BIO) will help to maintain national robustness in these areas in conjunction with allied research in other NSF directorates and other agencies. The increase will be used to enhance support for strategic initiatives through increasing the size and duration of awards in these areas.

NSF and Interagency Initiatives:

This request provides funding for the continuance of BIO's leading role within the agency in support of both biotechnology and research on the environment as well as funding for other NSF and interagency initiatives. The following table summarizes BIO's funding level for these initiatives:

(Millions of Dollars)

Initiative	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Biotechnology	$113.20	$119.30	$6.10
Environment	63.60	70.10	6.50
Advanced Materials Processing Program	9.00	9.40	0.40
Global Change	9.85	11.35	1.50
High Performance Computing & Communications	9.00	12.49	3.49
Math & Science Education	22.42	27.42	5.00

The initiatives displayed in the above table increased by $22.99 million and consist of support for the following research activities:

- $6.10 million increase in Biotechnology will continue efforts begun in FY 1993 to support research in five focal areas: environmental biotechnology; bioprocessing; bioelectronics and bionetworks; agricultural biotechnology; and marine biotechnology.

- $6.50 million increase in Environmental Biological Research to enhance research activities and provide start-up support for an Ecological Synthesis and Analysis Center. This Center will promote the study of complex ecological questions and serve as a site for synthesis of large data sets.

- $3.49 million increase in High Performance Computing & Communication expands support for multidisciplinary teams of biologists, mathematicians, and computer and information scientists to apply emerging technologies to crucial biological research problems, such as brain mapping, environmental modeling, and protein folding.

- $1.50 million increase for the Global Change Research Program will continue expansion of studies of the effects of global change, especially climate change on ecosystems.

- $0.40 million increase for the Advanced Materials Processing Initiative supports continued research leading to new biomolecular materials.

- $5.00 million increase in Math and Science Education activities will initiate a new competition for Research Training Groups in strategic initiative areas; RTGs provide training support for undergraduate, graduate, and postdoctoral teams of students in a multidisciplinary research setting.

Other Increases:

- The FY 1994 request will allow progress toward enablement by providing larger individual investigator awards and enhanced support for instrumentation ($3.75 million), and students ($3.0 million).

- $1.50 million increase for the Plant Science Initiative & Genome Project, for a total of $18.0 million, will continue the multi-national Arabidopsis genome project and provide for the third year of the interagency, NSF, USDA, and DOE, plant science initiative.

- $0.52 million will enhance support of the Science and Technology Centers in the biological sciences; with this increase all six STCs within BIO will have reached National Science Board authorized levels of support for a total of $13.12 million.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Molecular and Cellular Biosciences	$95.50	$88.20	$ -7.30
Integrative Biology and Neuroscience	88.47	82.20	-6.27
Environmental Biology	86.49	77.09	-9.40
Biological Instrumentation and Resources ..	50.17	43.97	-6.20
	--------	--------	--------
Total, Subactivity	$320.63	$291.46	$-29.17

The FY 1993 Revised Current Plan is $291.46 million, a decrease of $29.17 million, or 9.1 percent, from the FY 1993 Request. The change is due to unspecified Congressional reductions and will result in fewer awards being made. The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993 which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request".

MOLECULAR AND CELLULAR BIOSCIENCES: $94,110,000

Research supported by the Molecular and Cellular Biosciences Subactivity increases our understanding of the fundamental molecular principles and cellular processes underlying biological phenomena. In addition to disciplinary support of Biochemistry, Biophysics, Cell Biology and Genetics, all programs emphasize the support of interdisciplinary research where contemporary bioscience intersects with engineering, physical science, and mathematics.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Biochemistry and Molecular Structure and Function	$33.58	$37.96	$35.30	$37.40	$2.10
Cell Biology	19.01	22.08	20.40	21.95	1.55
Genetics and Nucleic Acids	30.54	35.46	32.50	34.76	2.26
	--------	--------	--------	--------	--------
Total, Subactivity	$83.13	$95.50	$88.20	$94.11	$5.91

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Molecular and Cellular Biosciences is $94.11 million, an increase of $5.91 million above the FY 1993 Revised Current Plan of $88.20 million.

Explanation of Increases:

- $2.10 million increase in the Biochemistry and Molecular Structure and Function Program will enable such emerging molecular capabilities as atomic-force microscopy, optical tweezers, and genetic engineering to accelerate the structural determination of key biological macromolecules. This growing revolution in structural biology is vital to understanding the molecular structure and function relationships which underlie contemporary biological science.
- $1.55 million increase in Cell Biology will emphasize the study of plant cells, an area that is now poised to make rapid progress. Research in this area will, for example, increase our understanding of the mechanisms of membrane function in plant systems and how plant cells respond to key environmental signals.
- $2.26 million increase in the Genetics and Nucleic Acids Program will support studies which are challenging the "classic" notion of a gene. These studies include, for example, parental effects on gene expression and stability ("imprinting"), nuclear attachment sites and gene expression, and the editing of genetic messages leading to the production of proteins whose composition cannot be deduced from the original gene sequence.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Biochemistry and Molecular Structure and Function	$37.96	$35.30	$ -2.66
Cell Biology	22.08	20.40	-1.68
Genetics and Nucleic Acids	35.46	32.50	-2.96
Total, Subactivity	$95.50	$88.20	$-7.30

The FY 1993 Revised Current Plan is $88.20 million, a decrease of $7.30 million from the FY 1993 Budget Request. When compared to FY 1992, the FY 1993 Revised Current Plan provides an increase of $5.07 million. The decrease from the FY 1993 Budget Request is due to unspecified Congressional Reductions which have slowed progress in both plant biology and structural biology.

INTEGRATIVE BIOLOGY AND NEUROSCIENCE: $88,000,000

Integrative Biology and Neuroscience (IBN) emphasizes the integration of molecular and cellular approaches to understand the development, function, and behavior of organisms in laboratory and natural settings; and the functional and behavioral interactions of organisms with their environment. Much of the research is interdisciplinary, with areas such as engineering, computer science, mathematics, social science, psychology, physical science, and earth science, being increasingly necessary to comprehend the full range of integrated organismic functions, the nervous system, and physiological ecology.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Physiology and Behavior	$30.18	$35.32	$32.16	$34.30	$2.14
Neuroscience	31.14	33.67	33.14	35.51	2.37
Developmental Biology	15.87	19.48	16.90	18.19	1.29
	--------	--------	--------	--------	--------
Total, Subactivity	$77.19	$88.47	$82.20	$88.00	$5.80

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Integrative Biology and Neuroscience is $88.00 million an increase of $5.8 million above the FY 1993 Revised Current Plan of $82.20 million.

Explanation of Increases:

- $2.14 million increase in Physiology and Behavior will augment award size, especially in environmental and plant biology. This will promote the use of molecular and cellular tools to unravel the mechanisms of organismal adaptation, enhance collaborative investigations of the behavioral mechanisms of ecological phenomena, and support investigators in the conduct of research at Long Term Ecological Research (LTER) sites.

- $2.37 million increase in Neuroscience will allow further growth of the emerging fields of neuroscience, especially computational neuroscience. The number of multidisciplinary awards will increase and collaborative research initiation grants will be instituted in the interagency brain mapping project.

- $1.29 million increase in Developmental Biology will be used to fully enable collaborative research projects in areas such as the evolution of developmental mechanisms and the mapping and regulation of gene networks. There will be an increase in the numbers of highly competitive investigators supported at levels necessary for optimal conduct of their research.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Physiology and Behavior	$35.32	$32.16	$ -3.16
Neuroscience	33.67	33.14	-0.53
Developmental Biology	19.48	16.90	-2.58
	--------	--------	--------
Total, Subectivity	$88.47	$82.20	$-6.27

The FY 1993 Revised Current Plan is $82.20 million, a decrease of $ 6.27 million from the FY 1993 Budget Request. The FY 1993 Revised Current Plan provides an increase of $5.0 million over the FY 1992 level. The decrease from the FY 1993 Budget Request is due to unspecified Congressional reductions which have slowed progress in both developmental biology and physiology and behavior programs.

ENVIRONMENTAL BIOLOGY: $83,090,000

Environmental Biology programs provide an interdisciplinary focus on origins, functions, relationships, interactions and evolutionary history of organisms, populations, species, communities and ecosystems through support for research. The Division also supports the network of Long Term Ecological Research sites and curatorial improvement and computerization of research collections.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Systematic and Population Biology	$21.24	$25.67	$24.40	$25.90	$1.50
Ecological Studies	26.34	30.46	26.92	29.42	2.50
Long-Term Projects in Environmental Biology	25.06	30.36	25.77	27.77	2.00
	--------	--------	--------	--------	--------
Total, Subactivity	$72.64	$86.49	$77.09	$83.09	$6.00

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Environmental Biology is $83.09 million, an increase of $6.00 million above the FY 1993 Revised Current Plan of $77.09 million.

Explanation of Increases:

- $1.5 million increase in Systematics and Population Biology will fund increased award size and allow growth in basic research on Environmental Biology and Molecular Evolution; research in this program provides important contributions towards understanding the diversity of life and its future preservation.

- $2.5 million increase in Ecological Studies will provide additional support for Global Change research and enhancement of High Performance Computing and Communications (HPCC) applications in ecology and ecosystem science. Award size for basic research will be increased.

- $2.0 million increase in Long-Term Projects in Environmental Biology and development of a National Center for Ecological Synthesis and Analysis; planning activities for this center were begun in FY 1993.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Systematic and Population Biology	$25.67	$24.40	$ -1.27
Ecological Studies	30.46	26.92	-3.54
Long-Term Projects in Environmental Biology .	30.36	25.77	-4.59
	--------	--------	--------
Total, Subactivity	$86.49	$77.09	$-9.40

The FY 1993 Revised Current Plan is $77.09 million, a decrease of $9.40 million from the FY 1993 Budget Request; in comparison to FY 1992, the FY 1993 Revised Current Plan provides an increase of $4.45 million. The decrease from the FY 1993 Budget Request is due to unspecified Congressional Reductions which have slowed progress in research on environmental biology and establishment of a National Center for Ecological Synthesis and Analysis.

BIOLOGICAL INSTRUMENTATION AND RESOURCES: $46,710,000

Biological Instrumentation and Resources focuses on providing the infrastructure required to enable contemporary research in the biological sciences. Infrastructure needs include support for major items of multi-user equipment, development of new instrumentation, software, computational tools, specialized databases and other enabling technologies. Support is also provided for training young scientists through multidisciplinary training groups.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Instrumentation and Instrument Development .	$13.97	$18.45	$14.10	$14.85	$0.75
Special Projects	27.41	31.72	29.87	31.86	1.99
	--------	--------	--------	--------	--------
Total, Subactivity	$41.38	$50.17	$43.97	$46.71	$2.74

FY 1943 BUDGET REQUEST

The FY 1994 Budget Request for Biological Instrumentation and Resources is $46.71 million, an increase of $2.74 million above the FY 1993 Revised Current Plan of $43.97 million.

Explanation of Increases:

- $0.75 million increase in Instrumentation and Instrument Development provides for acquisition of multi-user equipment to enable scientists and groups of scientists to progress in crucial research areas for BIO such as the environment, biotechnology, and advanced materials.

- $1.99 million increase in Special Projects provides for support of interdisciplinary research training groups in crucial research areas such as computational biology, biotechnology and multidisciplinary environmental research. Support is also provided for increased participation in High Performance Computing and Communication activities and other high priority infrastructure, particularly applications of advanced computers and computational techniques to biological problems, as well as postdoctoral training across computer and biological disciplines and development of specialized software, techniques and equipment that will enable biologists and computational scientists to work together.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Instrumentation and Instrument Development	$18.45	$14.10	$ -4.35
Special Projects	31.72	29.87	-1.85
	--------	--------	--------
Total, Subactivity	$50.17	$43.97	$-6.20

The FY 1993 Revised Current Plan is $43.97 million, a decrease of $6.2 million from the FY 1993 Budget Request, but an increase of $2.59 million over FY 1992. The decrease is due to unspecified Congressional Reductions. The reductions have slowed provision of multi-user equipment, and development of computational and database tools for the biological sciences.

COMPUTER & INFORMATION SCIENCE & ENGINEERING: $296,010,000

The Computer and Information Science and Engineering Activity (CISE) supports research fundamental to computing and information processing, provides access to advanced computing capabilities, develops a national research and education computing and communications network, and improves the education and human resource base in its disciplines. As a creator of diverse enabling technologies, CISE plays a major role in the federal interagency High Performance Computing and Communications (HPCC) and Advanced Manufacturing Technologies programs, takes part in the Advanced Materials and Processing Program (AMPP), Biotechnology, and Mathematics and Science Education (MSE) initiatives, and stimulates research on a broad range of Grand Challenge Applications problems and national information infrastructure applications.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change Amount	Change Pcnt
Computer and Computation Research	$ 34.78	$ 43.04	$ 41.42	$ 46.07	$ 4.65	11.2
Information, Robotics and Intelligent Systems	26.90	36.83	35.84	40.62	4.78	13.3
Microelectronic Information Processing Systems	21.44	30.44	28.20	32.83	4.63	16.4
Advanced Scientific Computing	69.43	86.71	82.25	91.27	9.02	11.0
Networking and Communications Research and Infrastructure	35.38	48.09	48.09	54.94	6.85	14.2
Cross-Disciplinary Activities	22.45	27.11	27.11	30.28	3.17	11.7
Total, Activity	$210.38	$272.22	$262.91	$296.01	$33.10	12.6

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Computer and Information Science and Engineering is $296.01 million, an increase of $33.10 million or 12.6 percent over the FY 1993 Revised Current Plan of $262.91 million.

NSF and Interagency Initiatives:

This request provides support for CISE's role in five strategic research and interagency initiatives coordinated by the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). CISE has the NSF lead in the HPCC program, plays a major role in the Manufacturing initiative by creating its critical intelligent information base, and supports the AMPP, Biotechnology, and MSE programs. The table below shows the funding levels for these activities:

(Millions of Dollars)

Initiative	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
High Performance Computing & Communications	228.63	253.87	25.24
Advanced Manufacturing Technologies	31.40	38.65	7.25
Advanced Materials and Processing	19.50	20.11	0.61
Math & Science Education	10.32	11.14	0.82

CISE will maintain Biotechnology at its current level.

The FCCSET initiatives displayed in the above table increase $33.92 million and consist of support for the following research activities:

- High Performance Computing and Communications: provides for new Grand Challenge applications, a coordinated effort in problem solving environments; research in massively parallel algorithms for intelligent systems; strengthening and broadening access to emerging scalable parallel architectures; research on new high performance architectures and computing systems; extending very high speed backbone service and enhancing regional network infrastructure; and increasing human infrastructure support.

- Advanced Manufacturing Technologies: increases research on high dependability computer controlled systems; methods of integrating information access and intelligent functions and interfaces into design, production, and material handling; distributed design and manufacturing; intelligent dataservers; and developing network protocols for factory floor applications.

- Advanced Materials and Processing: for modeling and simulation of electronic materials and devices and research on the role of new optical materials and devices in optoelectronic computing.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Computer and Computation Research	$ 43.04	$ 41.42	$ -1.62
Information, Robotics and Intelligent Systems	36.83	35.84	-0.99
Microelectronic Information Processing Systems	30.44	28.20	-2.24
Advanced Scientific Computing	86.71	82.25	-4.46
Networking and Communications Research and Infrastructure	48.09	48.09	0.00
Cross-Disciplinary Activities	27.11	27.11	0.00
	--------	--------	--------
Total, Subactivity	$272.22	$262.91	$-9.31

The FY 1993 Revised Current Plan is $262.91 million, a decrease of $9.31 million or 3.4 percent from the FY 1993 Request. The change is due to unspecified Congressional reductions and will result in fewer awards being made. The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993 which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request".

CHANGES IN BUDGET STRUCTURE

The new budget structure consolidates program elements in the Computer and Computation Research; Information, Robotics, and Intelligent Systems; Microelectronic Information Processing Systems; and Cross Disciplinary Activities subactivities.

CROSSWALK - FY 1993 CURRENT PLAN

<——OLD STRUCTURE——>		<——NEW STRUCTURE——					——>	
SUBACTIVITY/ Program Element		**Computer & Computation Research (CCR)**	**Information Robotics $ Intelligent Systems (IRIS)**	**Advanced Scientific Computing Systems (ASC)**	**Microelectronic Information Proceeding Systems (MIPS)**	**Networking Communications Research & Infrastruture (NCRI)**	**Cross Disciplinary Activities (CDA**	**TOTAL**
COMPUTER & COMPUTATION RESEARCH (CCR)								
Theory of Computing	$8.24							
Numeric,Symbolic & Geometric Computation	5.98							
Computer Systems and Graphics	3.93							
System Software	12.30							
Software Engineering	4.36							
SUBTOTAL, CCR	***$34.80***	***$34.80***						***$34.80***
INFORMATION, ROBOTICS & INTELLIGENT SYSTEMS (IRIS)								
Knowledge & Database Systems+STC	$11.85							
Robotics and Machine Intelligence	6.45							
Interactive Systems	4.25							
Information Tech. & Organizations	4.40							
SUBTOTAL, IRIS	***$26.95***		***$26.95***					***$26.95***
ADVANCED SCIENTIFIC COMPUTING (ASC)								
Centers+STC	$65.94			$65.94				
New Technologies	3.59			3.59				
SUBTOTAL, ASC	***$69.53***			***$69.53***				***$69.53***
MICROELECTRONIC INFORMATION PROCESSING SYSTEMS (MIPS)								
Design, Tools & Test	$4.10							
Microelectronic Systems Arch	3.88							
Circuits and Signal Processing	4.13							
Experimental Systems	6.92							
Systems Prototyping & Fabrication	2.47							
SUBOTAL, MIPS	***$21.49***				***$21.49***			***$21.49***
NETWORKING & COMMUNICATIONS RESEARCH & INFRASTRUCTURE (NCRI)								
NSFNET	$30.16					$30.16		
Networking & Communications Research	9.80					9.80		
SUBTOTAL, NCRI	***$39.96***					***$39.96***		***$39.96***
CROSS-DISCIPLINARY ACTIVITIES (CDA)								
CISE Institutional Infrastructure	$18.93							
CISE Instrumentation	3.56							
SUBTOTAL, CDA	***$22.49***						***$22.49***	***$22.49***
TOTAL, CISE	***$215.22***							***$215.22***

COMPUTER AND COMPUTATION RESEARCH: $46,070,000

The Computer and Computation Research Subactivity contributes to understanding of the fundamental theory of computation, alternative architectures for computer systems, and the methodology of and tools for designing software. This subactivity is a major source for academic research in these fields. Close collaboration is maintained with other federal agencies through a variety of formal and informal mechanisms.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Computer and Computation Research	$34.78	$43.04	$41.42	$46.07	$4.65
	--------	--------	--------	--------	--------
Total, Subactivity	$34.78	$43.04	$41.42	$46.07	$4.65

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Computer and Computation Research is $46.07 million, an increase of $4.65 million or 11.2 percent above the FY 1993 Revised Current Plan of $41.42 million.

Explanation of Increases:

The increase emphasizes HPCC and Manufacturing, providing a foundation for new generations of enabling technology for high performance computer systems and applications. In addition, average award size will be increased to fully enable and expedite research projects.

- High Performance Computing and Communications: provides for additional Grand Challenge applications, a coordinated effort in problem solving environments -- an enabling technology for scientists and engineers ($3.30 million).
- Advanced Manufacturing Technology: increases in Manufacturing for theory and experimentation in computer controlled systems requiring high dependability, advanced methods of system integration, and reduced costs of quality certification ($1.00 million).

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Computer and Computation Research	$43.04	$41.42	$ -1.62
	--------	--------	--------
Total, Subactivity	$43.04	$41.42	$-1.62

The FY 1993 Revised Current Plan is $41.42 million, a decrease of $ 1.62 million (or 3.8 percent) from the FY 1993 Request. As a result, emphasis will be maintained in FCCSET activities and decrease in other lower priority areas.

CHANGES IN BUDGET STRUCTURE

By consolidating previously separated program elements, the new budget structure responds to growing interdisciplinarity of the research in this subactivity, the need for complex multidisciplinary projects, and extensive involvement in large scale coordinated interagency activities. The same broad disciplinary areas will be covered, with the new arrangement providing for improved planning, minimization of overlap, and flexibility of response.

INFORMATION, ROBOTICS, AND INTELLIGENT SYSTEMS: $40,620,000

The Information, Robotics, and Intelligent Systems (IRIS) Subactivity supports research to develop a more productive work and living environment in a rapidly emerging information society. The principal goals are to improve basic understanding and design of information and knowledge processing mechanisms; to facilitate information and knowledge exchange between humans and machines; and to understand better the impact of advanced information technologies in distributed work environments. This Subactivity is a primary source of federal support for fundamental research in this area.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Information, Robotics and Intelligent Systems .	$26.90	$36.83	$35.84	$40.62	$4.78
	--------	--------	--------	--------	--------
Total, Subactivity	$26.90	$36.83	$35.84	$40.62	$4.78

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Information, Robotics, and Intelligent Systems is $40.62 million, an increase of $4.78 million or 13.3 percent above the FY 1993 Revised Current Plan of $35.84 million.

Explanation of Increases:

The increase selectively emphasizes HPCC and Advanced Manufacturing Technology, providing support for laying the foundation for new generations of enabling intelligent technology for high performance computer systems and applications. In addition, average award size will be increased to fully enable and expedite research projects.

- High Performance Computing and Communications: for research in massively parallel algorithms and other new computational models for intelligent systems and for expanding participation in Grand Challenge Applications ($1.95 million) .

- Advanced Manufacturing Technology for research integrating information access, knowledge bases, and intelligent functions and interfaces in design, production, materials handling, and quality control in the manufacturing process. Includes fundamental research on intelligent dataservers - a generic enabling technology for digital libraries, and virtual reality to improve information flow between human, machine and the physical environments ($2.77 million).

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Information, Robotics and Intelligent Systems	$36.83	$35.84	$ -0.99
	--------	--------	--------
Total, Subactivity	$36.83	$35.84	$-0.99

The FY 1993 Revised Current Plan is $35.84 million, a decrease of $990,000 (or 2.7 percent) from the FY 1993 Request. Emphasis will be maintained in FCCSET activities, and will decrease in other lower priority areas of research.

CHANGES IN BUDGET STRUCTURE

By consolidating previously separated program elements, the new budget structure responds to growing interdisciplinarity of research, to the need for complex multidisciplinary projects, and to extensive involvement in large scale coordinated interagency activities. The same broad disciplinary areas will be covered, with the new arrangement providing improved planning, minimization of overlap, and flexibility of response.

MICROELECTRONIC INFORMATION PROCESSING SYSTEMS: $32,830,000

The Microelectronic Information Processing Systems Subactivity (MIPS) supports research on computing, and information and signal processing systems. Its focus is on experimental research; environments and services for rapid prototyping of systems, design methodologies and tools, technology driven and application driven computer systems, and algorithms and architectures for signal processing. MIPS, because of its focus on managing design complexity and creating new functional capabilities plays a significant part in the HPCC and AMT programs. It closely collaborates with other NSF activities and other federal agencies, such as ARPA.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Microelectronic Information Processing Systems	$21.44	$30.44	$28.20	$32.83	$4.63
	--------	--------	--------	--------	--------
Total, Subactivity	$21.44	$30.44	$28.20	$32.83	$4.63

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Microelectronic Information Processing Systems is $32.83 million, an increase of $4.63 million or 16.4 percent over the FY 1993 Revised Current Plan of $28.20 million.

Explanation of Increases:

The increase emphasizes the interagency HPCC, Advanced Manufacturing Technology and Materials programs providing support laying the foundation for new generations of enabling technology for high performance computer systems and intelligent manufacturing. In addition, average award size will be increased to fully enable and expedite research projects.

- High Performance Computing and Communications ($1.65 million):
  - hardware and software research on new high performance architectures and computing systems; development of tools and CAD frameworks for related design, analysis and realization.

- Advanced Manufacturing Technology ($2.79 million):
  - research on fundamental information technology underlying modern design and manufacturing with special attention on distributed design and manufacturing ($1.64 million);

  - research on low power portable computing systems, involving energy conserving protocols and multimedia high performance systems for mobile access to digital libraries($800,000);

  - development of MOSIS-like fabrication services for distributed design and manufacturing of mechanical objects ($400,000); and

- intelligent dataservers involving "front ends" for fast access to large unstructured data and semantic searches of large databases and low power computer systems ($250,000).

- Advanced Materials and Processing ($190,000) modeling and simulation of electronic materials and devices and research on role of new optical materials and devices in optoelectronic computing.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Microelectronic Information Processing Systems	$30.44	$28.20	$ -2.24
Total, Subactivity	$30 44	$28.20	$-2.24

The FY 1993 Revised Current Plan is $28.20 million, a decrease of $2.24 million (7.4 percent) from the FY 1993 Budget Request. The decrease due to unspecified Congressional reductions, will maintain emphasis in FCCSET programs, and decrease other lower priority areas.

CHANGES IN BUDGET STRUCTURE

By consolidating previously separated program elements, the new budget structure responds to growing interdisciplinarity of research, the need for complex multidisciplinary projects, and extensive involvement in large scale coordinated interagency activities. The same broad disciplinary areas will be covered, with improved planning, minimization of overlap, and flexibility of response.

ADVANCED SCIENTIFIC COMPUTING: $91,270,000

The Advanced Scientific Computing Subactivity (ASC) supports advanced research on the development, use and application of state-of-the art high performance computing hardware and software systems. It provides the U.S. academic research community with access to state of the art hardware and software supercomputer systems, both vector and parallel, provides training at all levels, of systems and the educational range, works closely with industry on the use of these systems, and plays a key role in the HPCC program. ASC collaborates with other federal agencies to develop and exploit the use of cutting edge hardware and software.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Supercomputer Centers	$65.84	$75.81	$74.15	$80.37	6.22
New Technologies	3.59	10.90	8.10	10.90	2.80
	--------	--------	--------	--------	--------
Total, Subactivity	$69.43	$86.71	$82.25	$91.27	$9.02

FY 1994 BUDGET REQUEST

The 1994 Budget Request for Advanced Scientific Computing is $91.27 million, an increase of $9.02 million or 11.00 percent above the FY 1993 Revised Current Plan of $82.25 million. Support for High Performance Computing and Communications is increased by $3.15 million, Manufacturing by $460,000 and Materials by $420,000.

Explanation of Increases:

The increase emphasizes the interagency HPCC, Advanced Manufacturing Technology and Advanced Material Processing programs providing support laying the foundation for new generations of enabling technology for high performance computer systems, stimulating research on the solution of grand challenge applications, increasing access to and cooperation between advanced computing centers.

Centers increase of $6.22 million, or 8.4 percent provides:

- $4.22 million for continued strengthening of access to emerging scalable parallel architectures, the necessary environment for their support.
- $2.00 million for creation of Supercomputer Center Regional Affiliates to enable existing state and national Centers to serve as local gateways in the national information infrastructure.

New Technologies increase of $2.8 million, or 34.6 percent provides:

- $1.00 million to stimulate interdisciplinary use of advanced scalable systems in specific application areas such as computer science and biology and chemistry.

- $1.00 million for development of prototype software to strengthen computational science tools for Grand Challenge Applications and infrastructure.
- $800,000 to increase average award size.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Supercomputer Centers	$75.81	$74.15	$-1.66
New Technologies	10.90	8.10	-2.80
	--------	--------	--------
Total, Subectivity	$86.71	$82.25	$-4.46

The FY 1993 Revised Current Plan is $82.25 million, a decrease of $4.46 million (5.1 percent) from the FY 1993 Budget Request. The decrease, due to unspecified Congressional Reductions, slows implementation of joint disciplinary computational science programs.

NETWORKING & COMMUNICATIONS RESEARCH & INFRASTRUCTURE: $54,940,000

The Networking and Communications Research and Infrastructure Subactivity (NCRI) is responsible for development and operation of NSFNET, coordination of the National Research and Education Network part of the High Performance Computing and Communications program, and for fundamental research on communications theory and data networks. NCRI is involved in extensive collaborative development of national and international networks with other agencies. In leading the federal implementation of the NREN program, it has successfully managed the explosive growth of the national infrastructure providing access to information and computing resources to academic and industrial organizations in all 50 states.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
NSFNET	$25.62	$37.09	$37.09	$43.19	$6.10
Networking and Communications Research	9.76	11.00	11.00	11.75	0.75
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Total, Subactivity	$35.38	$48.09	$46.09	$54.94	$6.85

FY 1994 BUDGET REQUEST

The NCRI Activity increases by $6.85 million over the FY 1993 Revised Current Plan, to a total of $54.94 million or 14.2 percent.

Explanation of Increases:

The increase selectively emphasizes the National Research and Education Network (NREN) part of the HPCC program and supports Advanced Manufacturing Technology. In addition, average award size will be increased to fully enable and expedite research projects.

- High Performance Computing & Communications (HPCC) focusing on NREN will:
    - Extend very high speed backbone service, and enhance regional network infrastructure with high speed links for high bandwidth applications ($5.3 million).
    - Establish new network connections for educational institutions, not-for-profit research institutions, and libraries, and upgrade cost shared international network connections to NSFNET with research and education networks of other countries ($800,000)
    - Fund new gigabit testbed research to enable next generation computer networking ($520,000)
- Advanced Manufacturing Technology: research on network protocols for factory floor applications such as wireless access for collective, interactive behavior of remote automata, and remote multiuser interaction with common databases for concurrent engineering($230,000)

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
NSFNET	$37.09	$37.09	$0.00
Networking and Communications Research	11.00	11.00	0.00
	--------	--------	--------
Total, Subactivity	$48.09	$48.09	$0.00

The FY 1993 Revised Current Plan is $48.09 million, unchanged from the Budget Request.

CROSS-DISCIPLINARY ACTIVITIES: $30,280,000

The Cross-Disciplinary Activities Subactivity (CDA) is responsible for improving the long-term research and human resource infrastructure of the CISE fields. It builds essential shared research instrumentation infrastructure within academic institutions and improves and expands education and human resources through infrastructure development. CDA collaborates on education and human resource matters within the HPCC and EHR programs to gain maximum linkage between research and education with other NSF activities.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Cross-Disciplinary Activities	$22.45	$27.11	$27.11	$30.28	$3.17
	--------	--------	--------	--------	--------
Total, Subactivity	$22.45	$27.11	$27.11	$30.28	$3.17

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Cross Disciplinary Activities is $30.28, an increase of $3.17 million or 11.7 percent above the FY 1993 Revised Current Plan of $27.11 million. The increase emphasizes the Basic Research and Human Resources (BRHR) part of the HPCC program.

Explanation of Increases:

High Performance Computing and Communications:

- Acquisition of small-scale new architecture computers by university departments, Grand Challenge Application Group infrastructure, high speed optical/electrical communication network infrastructure, large information systems infrastructure, and demonstration projects on NREN in education and teacher training ($1.24 million).

- Human infrastructure activities including minority university research and education infrastructure; pilot projects to increase participation of women; and increased support of postdoctoral associates, and increased support for Research Experiences for Undergraduates and young investigators.($1.93 million) .

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Cross-Disciplinary Activities	$27.11	$27.11	$ 0.00
	--------	--------	--------
Total, Subactivity	$27.11	$27.11	$0.00

The FY 1993 Revised Current Plan is $27.11 million, unchanged from the Budget Request.

CHANGES IN BUDGET STRUCTURE

By consolidating previously separated program elements, the new budget structure responds to the growing interdisciplinarity of research and the need for complex multidisciplinary projects. The same disciplinary areas will be covered, with the new arrangement providing improved planning, minimization of overlap, and flexibility of responses.

ENGINEERING: $323,050,000

The Engineering Activity (ENG) seeks to enhance long-term economic strength, security and quality of life for the nation by fostering innovation, creativity and excellence in engineering education and research. An overall ENG strategy is to promote the natural synergy between engineering education, fundamental research, and the application of technical knowledge. Increasingly, ENG seeks to focus and integrate education and research in interdisciplinary areas such as manufacturing, civil infrastructure systems, biotechnology and materials processing. These efforts will develop the creative people and new fundamental knowledge required to meet the challenges of the 21st century, such as revitalizing the nation's deteriorating civil infrastructure and developing the advanced manufacturing and processing methods needed to strengthen the competitive position of U.S. industry. To amplify its efforts, ENG focuses on creating dynamic new partnerships among industry, academe, other Federal agencies, state and local governments, professional societies, and foreign countries. Overall, ENG provides about 30 percent of the total Federal support for engineering research at U.S. universities and colleges.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Biological and Critical Systems	$39.38	$46.02	$42.48	$45.42	$ 2.94	6.9
Chemical and Thermal Systems	36.30	43.56	39.17	42.27	3.10	7.9
Design and Manufacturing Systems	22.52	31.06	29.56	32.80	3.24	11.0
Electrical and Communications Systems	35.12	43.98	38.42	42.82	4.40	11.5
Engineering Education and Centers	75.42	88.56	87.04	92.71	5.67	6.5
Industrial Innovation Interface	24.16	29.99	32.92	36.89	3.97	12.1
Mechanical and Structural Systems	25.21	29.35	27.24	30.14	2.90	10.7
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Total, Activity	$258.11	$312.52	$296.83	$323.05	$26.22	8.8

FY 1994 BUDGET REQUEST

The ENG Activity increases by $26.22 million over the FY 1993 Revised Current Plan, to a total of $323.05 million. The request expands participation in several strategic interagency initiatives, and continues growth in other high priority areas, such as efforts to revitalize undergraduate engineering education.

NSF and Interagency initiatives:

ENG's participation in interagency initiatives and NSF-wide efforts in critical technology areas of national importance emphasizes support of individual investigators, small research groups and students. Within each initiative, support is provided by several ENG Subactivities. Specifically provided for are:

- A $7.50 million increase, to $80.40 million, to support ENG's effort in the interagency Advanced Manufacturing Technologies (AMT) initiative. Research will focus on next generation manufacturing cells and subsystems, computer-integrated tools for rapid prototyping and manufacture of products, and their integration into production systems. Part of this increase will fund a new Engineering Research Center focused on advanced manufacturing and processing.

- A $3.90 million increase, to $76.20 million, to support ENG's effort in the Advanced Materials and Processing (AMPP) initiative. ENG will continue to emphasize research to develop novel materials synthesis and processing methods. For example, within the Chemical and Thermal Systems and Electrical and Communications Systems Subactivities, research will support development of new processing techniques that are critical to the electronics industry.

- A $1.70 million increase, to $30.20 million, to support ENG's effort in the Biotechnology initiative, focusing on development of new technologies for bioprocessing, bioelectronics and bioremediation. The Biological and Critical Systems Subactivity, in coordination with other NSF elements, will concentrate on new engineering approaches for increasing productivity in and lowering the costs of health care systems.

- A $3.21 million increase, to $6.31 million, to support ENG's effort in the High Performance Computing and Communications (HPCC) initiative. Within the Electrical and Communications Systems Subactivity, research is focused on innovative optical computing and communications technologies. Problems associated with large-scale non-linear systems will also be supported.

- A $3.40 million increase, to $30.08 million to support ENG's efforts in the Math and Science Education Initiative. The components of this increase include $3.00 million, to $15.10 million, to start one or two new engineering education coalitions, bringing the total number funded to six. The coalitions are developing new approaches to undergraduate engineering education, including both curriculum content and instructional delivery systems. Also, a $400,000 increase, to $4.08 million, for the Research Experiences for Undergraduates (REU) program to support engineering students involved in industrially relevant research.

- A $2.60 million increase, to $42.00 million, to support a multidisciplinary research effort to develop new strategies and technologies for the intelligent renewal of the nation's decaying civil infrastructure systems, addressing such issues as system behavior and performance, deterioration, assessment, maintenance, repair and construction.

(Millions of Dollars)

Initiative	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Advanced Manufacturing Technologies	$72.90	$80 40	$7.50
Advanced Materials and Processing	72.30	76.20	3.90
Biotechnology	28.50	30.20	1.70
High Performance Computing & Communications	3.10	6.31	3.21
Math & Science Education	26.68	30.08	3 40

Other Increases:

A total of $36.89 million for the Industrial Innovation Interface Subactivity, which includes the following:

- An increase of $2.63 million, to $33.12 million, to meet the Research and Related Activities (R&RA) component of the Small Business Innovation Research Program at the 1.5 percent level mandated in the new Small Business Research and Development Enhancement Act of 1992(P.L. 102-564).

- An increase of $300,000, to $1.30 million for the continuation of the Management of Technological Innovation Program, in collaboration with the SBE Activity. Initial focus will be on environmentally-conscious manufacturing issues.

- $1.00 million for a new Industry/University Cooperative Research *Projects* Program, to link ideas, skills, and facilities of university and industry researchers.

An increase for the Engineering Education and Centers Subactivity of $5.67 million, to a total of $92.71 million, which includes:

- An increase of $2.50 million, to $52.50 million, for the Engineering Research Centers, to increase the number of centers from 18 to 20. The new ERCs will be focused on technologies associated with manufacturing, materials processing, and high performance computing and communications. Some funds made available from ERCs that have reached the end of their 11-year support cycle will be used to support the new centers.

- Continued funding for the Industry/University Cooperative Research *Centers* (I/UCRC) Program to support approximately 12 State centers and 50 regular centers. As support for mature centers declines, new centers will be established in technology areas important for the competitiveness of U.S. industry.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Biological and Critical Systems	$46.02	$42.48	$ -3.54
Chemical and Thermal Systems	43.56	39.17	-4.39
Design and Manufacturing Systems	31.06	29.56	-1.50
Electrical and Communications Systems	43.98	38.42	-5.56
Engineering Education and Centers	88.56	87.04	-1.52
Industrial Innovation Interface	29.99	32.92	2.93
Mechanical and Structural Systems	29.35	27.24	-2.11
	--------	--------	--------
Total, Subactivity	$312.52	$296.83	$-15.69

The FY 1993 Revised Current Plan is $296.83 million, a decrease of $15.69 million from the FY 1993 Budget Request due to Congressional reductions. The Revised Current Plan represents an increase of $38.72 million over FY 1992; it includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental." Funding for the interagency initiatives has been maintained at the Request level. The

Design and Manufacturing Systems Subactivity received less of a reduction because of Congressional direction to establish an institute for agile manufacturing through a competitive interagency process. The Industrial Innovation Interface Subactivity was increased over the Request level to meet increased, legislatively required targets for the Small Business Innovation Research Program. Decreases in base research programs affect lower priority areas such as thermal systems, earthquake hazard mitigation, and solid mechanics.

BIOLOGICAL AND CRITICAL SYSTEMS: $45,420,000

The Biological and Critical Systems (BCS) Subactivity is focused on: innovative engineering methods to solve problems in the life and health sciences; research in environmental engineering aimed at discovering principles and techniques that mitigate pollutant effects on land, water, and air; ocean engineering research concentrated on coastal ocean space utilization, advanced sensing and measuring techniques, structures, and vehicles; and hazard mitigation research concerned with measures to reduce the consequences of such phenomena as earthquakes, extreme winds, and landslides. Increasing emphasis is being given to civil infrastructure systems problems, including those related to lifeline and utility systems. NSF's hazard mitigation research is coordinated with the related activities of a number of other federal agencies.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Bioengineering and Aiding the Disabled	$14.06	$18.21	$16.44	$18.15	$1.71
Environmantal and Ocean Systems	6.24	7.40	6.59	6.59	0.00
Earthquake Hazard Mitigation	16.25	17.60	16.56	17.48	0.92
Natural and Man-Made Hazard Mitigation	2.83	2.81	2.89	3.20	0.31
	--------	--------	--------	--------	--------
Total, Subactivity	$39.38	$46.02	$42.48	$45.42	$2.94

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Biological and Critical Systems is $45.42 million, an increase of $2.94 million or 6.9 percent above the FY 1993 Current Plan of $ 42.48 million.

Explanation of Increases:

Bioengineering and Aiding the Disabled increase of $1.71 million, or 10.4 percent, provides special emphasis to (1) synthesis of new materials of biological origin, and living tissue equivalents; (2) research into bioprocess, biosensing, and biocontrol technologies; and (3) new approaches to increased productivity in the hospital environment, new technologies for low cost diagnosis and therapy, and improved information and communication systems for better health care access. The health care research thrust is being funded in partnership with the Whitaker Foundation, a private organization supporting biomedical research.

Environmental and Ocean Systems, no increase, provides continued emphasis on improved environmental remedial action, and utilization and sustainable development in the coastal ocean.

Earthquake and Hazard Mitigation increase of $920,000, or 5.6 percent, provides support for research to develop a comprehensive approach to correcting the deficiencies in the vast inventory of buildings throughout the U.S. exposed to seismic hazards. This will include analytical, experimental and field research that will provide the basis for reliable, efficient, and economical design methods for retrofitting existing hazardous buildings.

Natural and Man-Made Hazard Mitigation increase of $310,000, or 10.7 percent, provides support for research to develop strategies that both mitigate hazards and maintain the quality of the natural environment, especially as it relates to the coastal regions.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Bioengineering and Aiding the Disabled	$18.21	$16.44	$ -1.77
Environmental and Ocean Systems	7.40	6.59	-0.81
Earthquake and Hazard Mitigation	17.60	16.56	-1.04
Natural and Man-Made Hazard Mitigation ...	2.81	2.89	0.08
	--------	--------	--------
Total, Subactivity	$46.02	$42.48	$-3.54

The FY 1993 Revised Current Plan is $42.48 million, a decrease of $3.54 million (7.7 percent) from the FY 1993 Budget Request, but an increase of $3.10 million, or 7.9 percent, over FY 1992. It includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The decrease is due primarily to reductions in the requested level of earthquake and bioengineering research. Funding for the Biotechnology initiative, however, will be maintained at the Request level, and the Natural and Man-Made Hazard Mitigation program will increase slightly above the Request level in order to meet commitments for post-hurricane studies.

CHEMICAL AND THERMAL SYSTEMS: $42,270,000

The understanding of chemical and thermal processes at the molecular and macroscopic levels is fundamental to technological progress in energy production, environmental protection, pharmaceuticals, new materials, and foods. The Chemical and Thermal Systems Subactivity (CTS) focuses on support for fundamental and applied research in various areas of chemical processes and reactions, interfacial phenomena, mass transport phenomena, separation science, phase equilibrium thermodynamics, heat transfer and energy systems, combustion and thermal plasmas, and research concerning mechanisms and phenomena governing single and multiphase fluid flow, particle formation and transport, and fluid-solid system interaction. An initiative begun in FY 1992 supports research on environmentally-conscious chemical and thermal manufacturing, with pollution prevention as the goal rather than end-of-pipe- waste treatment. This thrust is coordinated with NSF's Chemistry Subactivity, the chemical process industry, and the Environmental Protection Agency.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Chemical Reaction Processes	$9.20	$10.88	$10.28	$11.39	$1.11
Interfacial, Transport and Separations Processes	9.11	11.40	9.85	10.25	0.40
Fluid, Particulate and Hydraulic Systems	9.79	11.39	10.07	10.78	0.71
Thermal Systems	8.20	9.89	8.97	9.85	0.88
	--------	--------	--------	--------	--------
Total, Subactivity	$36.30	$43.56	$39.17	$42.27	$3.10

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Chemical and Thermal Systems is $42.27 million, an increase of $3.10 million or 7.9 percent above the FY 1993 Current Plan of $39.17 million.

Explanation of Increases:

Chemical Reaction Processes increase of $1.11 million, or 10.8 percent, provides funds to expand the program in environmentally-conscious chemical manufacturing.

Interfacial, Transport and Separations Processes increase of $400,000, or 4.1 percent, provides new research with membrane processes for the isolation of fragile drug and related species from biotechnological synthesis processes.

Fluid, Particulate and Hydraulic Systems increase of $710,000, or 7.1 percent, provides the opportunity to take advantage of the power of supercomputers to model the underlying micro-physics of particulate and turbulent flow processes. Such understanding is critical to many industrial processes.

Thermal Systems increase of $880,000, or 9.8 percent, provides for studies in materials processing such as occurs in melt-solidification and in plasma processes that are so critical to the manufacture of computer chips and electronic devices.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Chemical Reaction Processes	$10.88	$10.28	$ -0.60
Interfacial, Transport and Separations Processes	11.40	9.85	-1.55
Fluid, Particulate and Hydraulic Systems	11.39	10.07	-1.32
Thermal Systems	9.89	8.97	-0.92
	--------	--------	--------
Total, Subactivity	$43.56	$39.17	$-4.39

The FY 1993 Revised Current Plan is $39.17 million, a decrease of $4.39 million (10.1 percent) from the FY 1993 Budget Request, but an increase of $2.87 million, or 7.9 percent, over FY 1992. The decrease is due to Congressional reductions. The Revised Current Plan includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The FY 1993 Request levels for the FCCSET initiatives in Advanced Materials and Processing, Advanced Manufacturing Technologies, and Biotechnology are maintained in the Revised Current Plan. Offsetting reductions have been made to research in base programs, such as thermal systems and transport phenomena.

DESIGN AND MANUFACTURING SYSTEMS: $32,800,000

The Design and Manufacturing Systems (DDM) Subactivity seeks to accelerate the development and application of advanced manufacturing technologies to improve the manufacturing capabilities of a broad spectrum of U.S. industries. By supporting research in underlying technologies such as concurrent design of products and processes, advanced materials processing and manufacturing methods, intelligent processing equipment, and computer-aided manufacturing, DDM will aid the transition from rigid mass production to flexible manufacturing. This shift will result in highly competitive manufacturing enterprises, capable of responding quickly and cost-effectively to rapidly changing market demands.

A vital part of this effort is the development of operations research and production systems methodologies that underpin the full range of engineering systems. DDM coordinates its programs with industry and with relevant mission agencies. For example, its Strategic Manufacturing Initiative received major support from the Defense Department's Manufacturing Technology program.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Operations Research and Production Systems .	$5.86	$8.00	$7.55	$8.35	$0.80
Design and Integration Engineering	5.81	7.90	7.49	8.29	0.80
Manufacturing Processes and Equipment	10.85	15.16	14.52	16.16	1.64
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Total, Subactivity	$22.52	$31.06	$29.56	$32.80	$3.24

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Design and Manufacturing Systems is $32.80 million, an increase of $3.24 million or 11.0 percent above the FY 1993 Current Plan of $29.56 million.

Explanation of Increases:

Operations Research and Production Systems increase of $800,000, or 10.6 percent, provides for the development of mathematical optimization techniques that can be applied to product design, and production, scheduling, and distribution problems.

Design and Integration Engineering increase of $800,000, or 10.7 percent, provides for the development of the methodologies and tools necessary for the design process itself and for moving product designs through to actual manufacturing operations.

Manufacturing Processes and Equipment increase of $1.64 million, or 11.3 percent, provides support for the development of innovative new processing and net shape manufacturing techniques for advanced materials, and advanced methods (with appropriate sensors) for computer control of production processes.

Also included within the DDM total request are sustained support for an industry-led institute for agile manufacturing, initiated in FY 1993, that focuses on moving newly developed innovations to industry, support for the engineering faculty internships, and the research deployment teaching initiative to further encourage faculty to conduct research within an industrial setting.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Operations Research and Production Systems	$8.00	$7.55	$ -0.45
Design and Integration Engineering	7.90	7.49	-0.41
Manufacturing Processes and Equipment	15.16	14.52	-0.64
	--------	--------	--------
Total, Subactivity	$31.06	$29.56	$-1.50

The FY 1993 Revised Current Plan is $29.56 million, a decrease of $1.50 million (4.8 percent) from the FY 1993 Budget Request, but an increase of $7.04 million, or 31.3 percent, over FY 1992. The decrease is due to Congressional reductions. The Revised Current Plan includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The Revised Current Plan, however, maintains funding for the AMT and AMPP initiatives at the Request level, and also provides $5.00 million, as directed by Congress, for an institute for agile manufacturing, in partnership with the Department of Defense.

CHANGES IN BUDGET STRUCTURE

The Design and Computer-Integrated Engineering program element has been renamed to "Design and Integration Engineering" to better describe the broad nature of this program.

ELECTRICAL AND COMMUNICATION SYSTEMS: $42,820,000

The Electrical and Communications Systems (ECS) Subactivity supports fundamental research related to materials, devices, systems, and phenomena that involve electrical, electronic, electromechanical, or optical technologies. Funding is also provided for the development of analytical methods and computational algorithms for large scale simulation of engineering problems. Breakthroughs in nanotechnology microengineering, fostered in part by ECS-supported research, have increased our ability to manipulate and store enormous amounts of data, and have led to improved materials with controlled microstructures. These breakthroughs have also generated a multidisciplinary effort to create micromachines, such as electric motors the size of a grain of sand, micro-sized sensors, and actuators, with important applications in biomedical and other areas.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Quantum Electronics, Waves and Beams	$9.17	$11.90	$10.75	$11.71	$0.96
Solid State and Microstructures	10.47	13.80	11.50	12.76	1.26
Communications and Computational Systems .	6.03	8.20	5.58	6.84	1.26
Engineering Systems	7.88	8.40	9.49	10.41	0.92
Emerging Technologies Initiation	1.57	1.68	1.10	1.10	0.00
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Total, Subactivity	$35.12	$43.98	$38.42	$42.82	$4.40

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Electrical and Communication Systems is $42.82 million, an increase of $4.40 million or 11.5 percent above the FY 1993 Current Plan of $38.42 million.

Explanation of Increases:

Quantum Electronics, Waves and Beams increase of $960,000, or 8.9 percent, provides funding for research in plasma technologies for materials processing and for photonics device, and systems research, which is important to advances in computer and optical communications technologies.

Solid State and Microstructures increase of $1.26 million, or 11.0 percent, provides funding to develop closed-loop control of semiconductor fabrication equipment, advanced manufacturing processes and integrated microelectromechanical sensors and actuators. Fundamental understanding in these areas is essential to the future of the critical microelectronics industry. Continuation and expansion of nanofabrication services will be provided through a national network funded in conjunction with the MPS Activity.

Communications and Computational Systems increase of $1.26 million, or 22.6 percent, provides additional funding for research at the optical fiber/electronic device interface, and for important research issues related to interconnecting optical fiber networks and microwave and/or millimeter wave communications links. These contribute significantly to the national telecommunications infrastructure through the High Performance Computing and Communications initiative.

Engineering Systems increase of $920,000, or 9.7 percent, provides special emphasis to research on analytical and computational methods for modeling, optimization and control of advanced material processing equipment and processes, and on advanced sensor-based intelligent controllers for safe and reliable manufacturing systems operations.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Quantum Electronics, Waves and Beams	$11.90	$10.75	$ -1.15
Solid State and Microstructures	13.80	11.50	-2.30
Communications and Computational Systems	6.90	5.58	-1.32
Engineering Systems	9.70	9.49	-0.21
Emerging Technologies Initiation	1.68	1.10	-0.58
	--------	--------	--------
Total, Subactivity	$43.98	$38.42	$-5.56

The FY 1993 Revised Current Plan is $38.42 million, a decrease of $5.56 million (12.6 percent) from the FY 1993 Budget Request, but an increase of $3.30 million, or 9.4 percent, over FY 1992. The decrease is due to Congressional reductions. The Revised Current Plan includes the Presidents's stimulus package for FY 1993, which is described in the section on the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The Revised Current Plan retains the requested funding for the Advanced Materials Processing, the Advanced Manufacturing Technologies, Biotechnology and High Performance Computing and Communications initiatives. There are offsetting reductions in such areas as electric power systems research and emerging technologies initiation.

CHANGES IN BUDGET STRUCTURE

The Neuroengineering component of the Communications and Computational Systems Program Element has been moved to the Engineering Systems Program Element to better reflect the emphasis on Control Systems.

ENGINEERING EDUCATION AND CENTERS: $92,710,000

The Engineering Education and Centers (EEC) Subactivity seeks to stimulate new paradigms in engineering research and education that will speed technological innovation and improve the quality and diversity of engineering graduates and the technical workforce. To achieve its mission, EEC forms partnerships across sectors. Disciplines are integrated to focus on technological systems, academe is linked with industry and the states, and diverse academic institutions are joined in educational innovation.

The Subactivity emphasizes new strategies--such as educational coalitions, alternative curricula, and innovative materials for training the technical workforce--that will produce graduates with sound technical and problem-solving skills, as well as provide a variety of means of support to attract and retain a broad base of engineering students representative of the full range of diversity in the American population. This Subactivity also includes the Engineering Research Centers, which have created a network of alternative research environments where teams of faculty, students, industry representatives carry out fundamental research crucial to engineering systems and next-generation technological advances. The Industry/University Cooperative Research Centers encourage industry/university cooperation by developing research programs defined by the firms supporting each Center. The State/Industry University Cooperative Research Centers is a joint initiative between the states and NSF to support research and other activities that contribute significantly to local economic development and the competitiveness of U.S. industry.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 v. FY 1993
Engineering Education	$11.93	$18.49	$15.40	$18.40	$3.00
Human Resources Development	9.29	9.65	12.44	12.61	0.17
Engineering Research Centers (ERCs)	47.50	53.22	50.00	52.50	2.50
Industry/University Cooperative Research Centers (I/UCRCs)	6.70	7.20	9.20	9.20	0.00
Total, Subactivity	$75.42	$88.56	$87.04	$92.71	$5.67

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Engineering Education and Centers is $92.71 million, an increase of $5.67 million or 6.5 percent above the FY 1993 Current Plan of $ 87.04 million.

Explanation of Increases:

Engineering Education increase of $3.00 million, or 19.5 percent, provides one or two new engineering education coalitions, bringing the total number funded to six, and also provides for full support for one coalition initiated in FY 1993. The coalitions are developing new approaches to undergraduate engineering education, including both curriculum content and instructional delivery systems. ENG coordinates this initiative with the Education and Human Resources Activity.

Human Resources Development increase of $170,000, or 1.4 percent, provides funding to sponsor Research Experiences for Undergraduates awards for selected I/UCRCs and State I/UCRCs to bring students from around the country to their laboratories for the summer to become involved in industrially relevant research.

Engineering Research Centers increase of $2.50 million, or 5.0 percent, provides an increase in the number of centers from 18 to 20. The new ERCs will be focused on technologies associated with manufacturing, materials processing and high performance computing and communications. Some funds made available from ERCs that have reached the end of their 11-year support cycle will be used to support the new centers. Modest increases may also be provided to selected existing centers as they expand their activities, establish research consortia with other ERCs, and increase support for undergraduate students.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Engineering Education	$18.49	$15.40	$ -3.09
Human Resources Development	9.65	12.44	2.79
Engineering Research Centers (ERCs)	53.22	50.00	-3.22
Industry/University Cooperative Research Centers (I/UCRCs)	7.20	9.20	2.00
Total, Subactivity	$88.56	$87.04	$-1.52

The FY 1993 Revised Current Plan is $87.04 million, a decrease of $1.52 million (1.7 percent) from the FY 1993 Budget Request, but an increase of $11.62 million, or 15.4 percent, over FY 1992. It includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The decrease is due to Congressional reductions. Only one new ERC and one new education coalition will be started in FY 1993. Human Resources Development will increase to meet commitments for graduate engineering education traineeships. The increase for I/UCRCs will augment the base level of support for centers that are directly involved in FCCSET initiatives, as well as fund two new State I/UCRCs.

INDUSTRIAL INNOVATION INTERFACE: $36,890,000

The Industrial Innovation Interface (III) Subactivity has primary responsibility for a range of research and analysis programs that promote U.S. industrial productivity. These programs aim to improve the speed and efficiency by which the results of NSF research and technology are transferred to the marketplace. The SBIR Program, inaugurated by NSF in 1977, later expanded by Congress into a government-wide program, and reauthorized last year (The Small Business Research and Development Enhancement Act of 1992, P.L. 102-564) helps small businesses with strong research capabilities pursue innovations leading to rapid commercialization of new products and processes. Other programs seek to develop the knowledge base for enhancing economic benefits from engineering and technological progress, and also support policy studies and international technology assessments, including the Japanese Technology Evaluation Center (JTEC). A new program element, Industry/University Cooperative Projects, will concentrate on linking the ideas, skills, and facilities of industry and university researchers.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Small Business Innovation Research	$22.87	$27.79	$30.49	$33.12	$2.63
Management of Technological Innovation	0.00	1.00	1.00	1.30	0.30
Spacial Studies and Assessments	1.29	1.20	1.43	1.47	0.04
Industry/University Cooperative Projects	0.00	0.00	0.00	1.00	1.00
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Total, Subactivity	$24.16	$29.99	$32.92	$36.89	$3.97

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Industrial Innovation Interface is $36.89 million, an increase of $3.97 million or 12.1 percent above the FY 1993 Current Plan of $32.92 million.

Explanation of Increases:

Small Business Innovation Research increase of $2.63 million, 8.6 or percent, provides funding at the 1.5 percent of extramural research mandated by the new Act. The SBIR program will continue to support high quality research and emphasize commercialization of the research results from NSF support. The program will give special emphasis in the selection of research awards to critical technology areas, such as manufacturing, high performance computing and communications, materials processing, and biotechnology.

Management of Technological Innovation increase of $300,000, or 30.0 percent, provides continued support for interdisciplinary teams consisting of engineering, business, and management scholars conducting research with industry partners. Focus will continue on the management and organizational aspects of the environmentally sound manufacturing processes and systems. The increment will fund a new research topic, such as health care technologies or enterprise design.

The Special Studies and Assessments Program increase of $40,000, or 2.8 percent, provides new international technology assessments in areas such as optoelectronics and biotechnology.

The new Industry/University Cooperative Research Projects Program will support an increase in the knowledge base that underlies new technologies by linking the ideas, skills, and facilities of industry and university researchers. Formal cooperative projects are proposed and performed by teams of university and industry researchers. Together, they identify and perform unique research activities, translating basic engineering into technological knowledge.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Small Business Innovation Research	$27.79	$30.49	$ 2.70
Management of Technological Innovation ...	1.00	1.00	0.00
Special Studies and Assessments	1.20	1.43	0.23
	--------	--------	--------
Total, Subactivity	$29.99	$32.92	$2.93

The FY 1993 Revised Current Plan is $32.92 million, a increase of $2.93 million (9.8 percent) from the FY 1993 Budget Request, and an increase of $ 8.76 million, or 36.3 percent, over FY 1992. It includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The increase over the FY 1993 Request is due primarily to the new SBIR act, which requires NSF to raise its SBIR program funding from 1.25 percent of extramural research to 1.5 percent during FY 1993 and FY 1994. Special Studies and Assessments has been increased by $230,000 above the requested level to support new international technology assessments in electronics packaging, micromachines and environmentally sound manufacturing.

CHANGES IN BUDGET STRUCTURE

The name of the Management of Technology Program has been changed to Management of Technological Innovation to emphasize the importance of the innovation process in industrial competitiveness.

A new program element, Industry/University Cooperative Projects, has been added.

MECHANICAL AND STRUCTURAL SYSTEMS: $30,140,000

The Mechanical and Structural Systems Subactivity supports research that leads to the creation of new and more cost-effective structures and mechanical systems Results are directly applicable to the improvement of public and private facilities (e.g. building codes), manufacturing processes, and the reduction of environmental problems. A primary objective is the enhancement of the knowledge base in the broad areas of structures, geomechanics, solid mechanics, materials engineering, tribology, surface engineering, and mechanical systems. Some specific areas of research are the development of new and improved materials, understanding the mechanisms of deterioration of constructed facilities, control of mechanical systems, and the development of repair and retrofit methods for decaying or damaged systems. An increasing interest area is that of civil infrastructure systems, i.e., facilities and lifelines by which society transports goods, provides clean air and water, manages health care, conducts commerce, and provides the foundation for society's economic well being and quality of life. A multidisciplinary effort has been initiated to develop advanced technologies for intelligent renewal of the nation's decaying civil infrastructure. This effort builds on NSF's current research and addresses issues of system behavior, performance, deterioration, assessment, and renewal.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Dynamic Systems and Control	$4.29	$4.62	$4.20	$4.87	$0.67
Structures, Geomechanics and Building Systems	8.98	9.73	10.12	10.95	0.83
Surface Engineering and Tribology	2.52	3.15	3.01	3.37	0.36
Mechanics and Materials	9.42	11.85	9.91	10.95	1.04
Total, Subactivity	$25.21	$29.35	$27.24	$30.14	$2.90

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Mechanical and Structural Systems is $30.14 million, an increase of $2.90 million or 10.7 percent above the FY 1993 Current Plan of $27.24 million.

Explanation of Increases:

Dynamic Systems and Control increase of $670,000, or 15.9 percent, provides research in modeling and simulation of innovative real-time sensor-based control of automated flexible manufacturing systems, which will lead to enhanced productivity and improvements in product quality and reliability.

Structures, Geomechanics and Building Systems increase of $830,000, or 8.2 percent, provides funding to improve system performance, and longevity of existing and future civil infrastructure systems utilizing deterioration science (failure, corrosion, fatigue, etc.), renewal engineering (repair/retrofit, structural control, construction automation, etc.), and assessment technologies (nondestructive evaluation, advanced instrumentation, expert systems, etc).

Surface Engineering and Tribology increase of $360,000, or 12.0 percent, provides support for research to achieve minimal and predictable friction via manipulation of the surface topography and/or microstructure and composition. This will result in energy savings in tool design and manufacturing processes.

Mechanics and Materials increase of $1.04 million, or 10.5 percent, provides support for research on material behavior in manufacturing processes, encompassing both mechanical and thermal inputs to determine and optimize the product quality.

Within the total requested amount, approximately $1.00 million is provided to foster research that bridges the traditional boundaries between the disciplinary areas of mechanics and materials science and engineering.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Dynamic Systems and Control	$4.62	$4.20	$ -0.42
Structures, Geomechanics and Building Systems	9.73	10.12	0.39
Surface Engineering and Tribology	3.15	3.01	-0.14
Mechanics and Materials	11.85	9.91	-1.94
	--------	--------	--------
Total, Subactivity	$29.35	$27.24	$-2.11

The FY 1993 Revised Current Plan is $27.24 million, a decrease of $2.11 million (7.2 percent) from the FY 1993 Budget Request, but an increase of $2.03 million, or 8.1 percent, over FY 1992. The decrease is due to Congressional reductions. The Revised Current Plan includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." Commitments to research for the Advanced Materials and Processing Program and for Advanced Manufacturing Technologies initiatives, however, are maintained at the FY 1993 Request level. The small increase in the Structures, Geomechanics and Building Systems program element reflects the increasing priority of research in civil infrastructure systems.

GEOSCIENCES: $448,530,000

The Geosciences (GEO) Activity supports research in the atmospheric, geological, and oceanographic sciences -- advancing scientific knowledge of the Earth's environment and the ability to predict natural phenomena of economic interest such as weather, climate and earthquakes. The geosciences disciplines require a broad base of scientific talent and a variety of instruments and facilities, including multi-user facilities such as research aircraft and vessels, global arrays of seismometers, and supercomputers, to accomplish their research objectives. The Foundation is the nation's principal supporter of academic basic research in the geosciences, providing about 70 percent of Federal support for research conducted at U.S. universities.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Atmospheric Sciences	$126.50	$151.93	$141.62	$149.10	$ 7.48	5.3
Earth Sciences	75.90	88.14	83.18	89.65	6.47	7.8
Ocean Sciences	177.50	206.36	196.24	209.78	13.54	6.9
Science and Technology Centers	0.93	0.00	0.00	0.00	0.00	N/A
Total, Activity /1	$380.83	$446.43	$421.04	$448.53	$27.49	6.5

/1 Excludes Arctic Research Programs which have been transferred in FY 1994 to the U.S. Polar Research Programs Appropriation

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for the Geosciences is $448.53 million, an increase of $27.49 million or 6.5 percent above the FY 1993 Revised Current Plan of $421.04 million.

NSF and Interagency Initiatives:

This request provides support for the GEO Activity participation in several interagency initiatives, which are coordinated by the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). Each GEO Subactivity provides a unique contribution to these interdisciplinary activities. The following table displays GEO funding for these initiatives:

(Millions of Dollars)

Initiative	FY 1993 Estimate	FY 1994 Estimate	Change FY 1994 vs. FY 1993
Advanced Materials	$ 0.00	$ 0.10	0.10
Global Change	120.22	124.80	4.58
High Performance Computing & Communications	1.72	3.79	2.07
Math & Science Education	9.10	7.32	-1.78

The decrease in the Mathematics and Science Education initiative is due to a reduction in undergraduate and postdoctoral support.

The NSF and interagency initiatives displayed in the above table increase a total of $6.75 million and consist of support for the following research activities:

- $4.58 million to augment Global Change research and facilities support across all Subactivities, including support for U.S. participation in large international field projects and climate modeling programs in the Atmospheric Sciences Subactivity and the joint expedition to the Indian Ocan and Arabian Sea in the Ocean Sciences;
- $2.07 million for High Performance Computing and Communications, including Grand Challenge activities in the Earth Sciences Subactivity and massively parallel processing at the National Center for Atmospheric Research; and
- $100,000 to begin interdisciplinary research on Advanced Materials.

Other Increases Include:

- $6.50 million for the initial steps of procurement of an Arctic research vessel in the Ocean Sciences Subactivity;
- $3.04 million for acquisition and deployment of digital seismographs in the Earth Sciences Subactivity to enhance capabilities of the Global Seismic Network;
- $2.65 million for covering the increased costs of international agreements in the Ocean Drilling Program in the Ocean Sciences Subactivity;
- $1.88 million for research on earthquake hazards and on the dynamics of the Earth's interior; and
- $500,000 for conversion of a surplus military C-130 aircraft into a research aircraft for the National Center for Atmospheric Sciences.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Atmospheric Sciences	$151.93	$141.62	$ -10.31
Earth Sciences	88.14	83.18	-4.96
Ocean Sciences	206.36	196.24	-10.12
	--------	--------	--------
Total, Subactivity	$446.43	$421.04	$-25.39

The FY 1993 Revised Current Plan is $421.04 million, a decrease of $25.39 million, or 5.7 percent, from the FY 1993 Request but an increase of $40.21 million, or 10.6 percent over FY 1992. The change is due to unspecified Congressional reductions and will result in fewer awards being made. The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993 which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request". Global Change research, environmental research and High Performance Computing and Communications will be funded at the requested level.

ATMOSPHERIC SCIENCES: $149,100,000

Research in the Atmospheric Sciences improves understanding and prediction of weather, climate, and the global environmental system by expanding the knowledge of the composition and behavior of the earth's atmosphere and geospace environment. One-third of the funds for Atmospheric Sciences are used for operation and maintenance of large, complex facilities required for research in the atmospheric science environment. The National Science Foundation provides approximately 50 percent of the total Federal support for basic research in atmospheric sciences.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Atmospheric Sciences Project Support	$68.53	$79.32	$78.60	$81.93	$3.33
National Center for Atmospheric Research ...	51.40	64.72	55.74	59.24	3.50
Upper Atmospheric Facilities	6.57	7.89	7.28	7.93	0.65
Total, Subactivity	$126.50	$151.93	$141.62	$149.10	$7.48

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Atmospheric Sciences is $149.10 million, an increase of $7.48 million or 5.3 percent above the FY 1993 Revised Current Plan of $141.62 million. Support for Global Change is increased by $1.54 million, to $45.02 million.

Explanation of Increases:

Atmospheric Sciences Project Support increase of $3.33 million, or 4.2 percent, provides:

- $1.04 million for Global Change research to provide continuing support for U.S. participation in large international field projects and climatic modeling programs;
- $1.67 million increased support of individual investigator research and the support for the U.S. Weather Research Program, approved by the Committee on Earth and Environmental Sciences (CEES) and issued by the Office of Science and Technology Policy (OSTP) in July 1992.
- $620,000 for support in High Performance Computing and Communications activities.

National Center for Atmospheric Research (NCAR) increases $3.50 million, or 6.3 percent, provides:

- $400,000 for Global Change research programs and facility support;
- $1.60 million for support of scientific research and operation of research facilities such as aircraft, radars, remote sensing devices and computers;
- $500,000 to convert a surplus military C-130 aircraft into a research aircraft as an addition to the NCAR fleet; and

- $1.00 million for continuing NCAR participation in the High Performance Computing and Communications initiative.

Upper Atmospheric Facilities increases $650,000, or 9.1 percent, provides:

- $100,000 for upper atmospheric facility contributions to observations related to Global Change research;

- $200,000 for upgrading computer hardware and software at the Sondrestrom Radar to develop and test remote operations and communications capabilities as a prototype for a national collaboratory; and

- $350,000 to meet increasing costs in operating and maintaining upper atmospheric radar facilities in the United States, Puerto Rico, Greenland, and Peru.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Atmospheric Sciences Project Support	$79.32	$78.60	$ -0.72
National Center for Atmospheric Research	64.72	55.74	-8.98
Upper Atmospheric Facilities	7.89	7.28	-0.61
	--------	--------	--------
Total, Subactivity	$151.93	$141.62	$-10.31

The FY 1993 Revised Current Plan is $141.62 million, a decrease of $10.31 million, or 6.8 percent, over the FY 1993 Budget Request, but an increase of $15.12 million, or 12.0 percent, over FY 1992. The decrease is due to unspecified Congressional reductions. The decrease in NCAR is mainly due to not providing for the replacement of the research aircraft and not increasing expenditures for operation and maintenance. Global Change research, environmental research and High Performance Computing and Communications will be funded at the requested level.

EARTH SCIENCES: $89,650,000

Earth Sciences research provides the fundamental understanding of Earth processes needed to resolve such practical problems as: the location and extraction of energy, water, and mineral resources; the human and environmental consequences of activities such as dam construction and the disposal of chemical and nuclear wastes; the prediction of earthquakes and volcanic eruptions; and the management of water resources. The National Science Foundation is the primary source of Federal funding for academic basic research in geology, geophysics, geochemistry, hydrology and related disciplines.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Earth Sciences Project Support	$49.65	$57.31	$55.05	$57.27	$2.22
Instrumentation and Facilities	19.54	22.62	20.97	24.92	3.95
Continental Dynamics	6.71	8.21	7.16	7.46	0.30
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Total, Subactivity	$75.90	$88.14	$83.18	$89.65	$6.47

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Earth Sciences is $89.65 million, an increase of $6.47 million or 7.8 percent above the FY 1993 Revised Current Plan of $83.18 million. Support for Global Change is increased by $910,000, to $13.55 million.

Explanation of Increases:

Earth Sciences Project Support increase of $2.22 million, or 4.0 percent, provides:

- $100,000 for interdisciplinary research on Advanced Materials;
- $240,000 to increase support for High Performance Computing and Communications relating to the Earth sciences; and
- $1.88 million for research on earthquake hazards and on the dynamics of the Earth's interior.

Instrumentation and Facilities increase of $3.95 million, or 18.8 percent, provides:

- $3.04 million for acquisition and deployment of digital seismographs to enhance capabilities of the Global Seismic Network; and
- $910,000 for instrumentation used in Global Change research.

Continental Dynamics increase of $300,000, or 4.2 percent, provides:

- $300,000 for collaborative studies of the continental crust.

A portion of the increases in Earth Sciences Project Support and Instrumentation and Facilities will be used to bring the two existing Science and Technology Centers up to cooperative agreement levels.

Funding for the National Earthquake Hazard Reduction Program will remain constant at $10.90 million.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Earth Sciences Project Support	$57.31	$55.05	$ -2.26
Instrumentation and Facilities	22.62	20.97	-1.65
Continental Dynamics	8.21	7.16	-1.05
	--------	--------	--------
Total, Subactivity	$88.14	$83.18	$-4.96

The FY 1993 Revised Current Plan is $83.18 million, a decrease of $4.96 million, or 5.6 percent, from the FY 1993 Budget Request, but an increase of $6.96 million, or 9.1 percent, over FY 1992. The decrease is due to unspecified Congressional reductions. Global Change research, environmental research and hydrologic sciences were given priority and funded at the requested level.

OCEAN SCIENCES: $209,780,000

Research in the Ocean Sciences seeks to improve the understanding of the ocean from the coastlines to the deep-ocean basins. The Ocean Sciences Subactivity supports research and operations of the international Ocean Drilling Program. NSF provides approximately 75 percent of the funds required for academic fleet operations. Two-thirds of the Ocean Sciences funds are used to support individual and group research activities; and one-third goes for operation and maintenance of shared-used facilities, primarily ships. The National Science Foundation supports approximately 70 percent of the total Federal support for basic research in ocean sciences.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Ocean Sciences Research Support	$ 90.03	$109.24	$108.18	$112.57	$4.39
Oceanographic Center and Facilities	51.22	59.32	50.26	56.76	6.50
Ocean Drilling Program	36.25	37.80	37.80	40.45	2.65
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Total, Subactivity	$177.50	$206.36	$196.24	$209.78	$13.54

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Ocean Sciences is $209.78 million, an increase of $13.54 million or 6.9 percent above the FY 1993 Revised Current Plan of $196.24 million. Support for Global Change is increased by $2.13 million, to $66.23 million.

Explanation of Increases:

Ocean Sciences Research Support increase of $4.39 million, or 4.1 percent, provides:

- $2.13 million for augmentation of Global Change research programs, including the joint expedition to the Indian Ocean and Arabian Sea;
- $2.05 million for collaborative research in coastal oceanography and for oceanic ridge crest processes; and
- $210,000 for increased participation in the High Performance Computing and Communications initiative of adapting existing models to the massively parallel computing environment.

Oceanograhic Centers and Facilities will increase by $6.50 million, or 12.9 percent, provides:

- $6.50 million for the initial steps of the procurement of an Arctic Research Vessel, a part of the academic fleet in the Ocean Sciences Subactivity, through charter or purchase.

Ocean Drilling Program (ODP) increase of $2.65 million, or 7.0 percent, provides:

- $2.65 million to meet the increased contribution in ODP support by the international partners.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Ocean Sciences Research Support	$109.24	$108.18	$ -1.06
Oceanographic Center and Facilities	59.32	50.26	-9.06
Ocean Drilling Program	37.80	37.80	0.00
	--------	--------	--------
Total, Subactivity	$206.36	$196.24	$-10.12

The FY 1993 Revised Current Plan is $196.24 million, a decrease of $10.12 million or 4.9 percent from the FY 1993 Budget Request, but an increase of $18.74 million, or 10.6 percent, over FY 1992. The decrease is due to unspecified Congressional reductions. Global Change research will be funded at the requested level.

MATHEMATICAL & PHYSICAL SCIENCES: $718,390,000

The Mathematical and Physical Sciences Activity supports research in the astronomical, chemical, materials, mathematical and physical sciences that contributes to an understanding of fundamental physical laws, establishes the base for future technological developments, and provides the building blocks for research of other disciplines. To carry out research and ensure future capabilities, the MPS disciplines require a pool of scientific talent and an array of facilities and instrumentation, including multi-user facilities such as supercomputers, radio and optical telescopes, accelerators and synchrotron radiation sources. The scientific requirements for sophisticated instrumentation drive the development of technology, while the MPS disciplines are the focal point for science, mathematics, and engineering education at all levels. NSF provides 38 percent of the total Federal support for academic-based research in the MPS disciplines, but is the major source of support in areas such as ground-based astronomy, core mathematics, and gravitational physics.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Mathematical Sciences	$ 78.42	$ 84.95	$ 82.09	$88.01	$ 5.92	7.2
Astronomical Sciences	112.22	120.00	110.64	113.94	3.30	3.0
Physics	138.07	148.57	137.90	142.60	4.70	3.4
Chemistry	112.11	125.95	122.25	130.89	8.64	7.1
Materials Research	143.54	167.49	159.55	170.95	11.40	7.2
Major Research Equipment	37.97	79.00	48.00	72.00	24.00	50.0
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Total, Activity	$622.33	$725.96	$660.43	$718.39	$57.96	8.8

FY 1994 BUDGET REQUEST

The MPS Activity increases by $57.96 million over the FY 1993 Revised Current Plan, to a total of $718.39 million.

NSF and Interagency initiatives:

This request provides support for MPS's participation in several interagency initiatives which are coordinated by the Federal Coordinating Council for Science, Engineering and Technology (FCCSET), as well as support for the NSF-wide initiatives in environment and civil infrastructure. Funding for these initiatives is broadly distributed throughout the MPS Activity, with each Subactivity providing its unique contribution. The following table displays MPS's funding level for the FCCSET initiatives:

(Millions of Dollars)

Initiative	FY 1993 Estimate Plan	FY 1994 Estimate	Change FY 1994 vs. FY 1993
Advanced Materials	$201.90	$206.44	$4.54
Biotechnology	19.30	21.50	2.20
Global Change	0.00	1.00	1.00
High Performance Computing & Communications	9.60	14.68	5.08
Manufacturing	4.40	6.80	2.40
Math & Science Education	22.65	30.85	8.20

The FCCSET initatives displayed in the above table increase a total of $ 23.42 million and consist of support for the following research activities:

- $4.54 million increase for the Advanced Materials and Processing Program to a total of $206.44 million. MPS is a materials driven Activity, with all Subactivities playing a role in this initiative, led by the Materials Research Subactivity;
- $5.08 million increase for High Performance Computing and Communications to a total of $14.68 million. Supported research includes projects in development of advanced software and algorithms for complex, multi-dimensional modeling including grand challenge studies, enhanced network support, and development of advanced software/hardware instrumentation for problem solving in the parallel environment;
- $2.20 million increase for the Biotechnology initiative to a total of $21.50 million. Focus will be on opportunities in areas such as bioprocessing, bioelectronics and biosensors, development of compact superconducting cyclotrons, and marine natural products;
- $1.00 million to initiate MPS participation in Global Change Research. This is led by the Mathematical Sciences Subactivity with an emphasis on modeling and predicting climate system behavior;
- $2.40 million increase for Manufacturing to a total of $6.80 million, focusing on the science of manufacturing, particularly on the processing of chemicals and materials and the modeling of those processes; and
- $8.20 million increase for the Mathematics and Science Education initiative to a total of $30.85 million. The increase will focus on opportunities for research experiences for undergraduate students and faculty, particularly those at minority institutions, improved integration of research and education activities, and enhancement of special postdoctoral fellowship opportunities, including academic/industrial possibilities.

MPS has taken the lead in working with other parts of the Foundation on a number of cross-directorate initiatives. An increase of $7.84 million in these areas provides:

- $2.94 million increase for research on the environment to a total of $11.74, building on the Chemistry Subactivity's environmentally benign synthesis and processing program;
- $900,000 to initiate MPS participation in civil infrastructure research. MPS will focus on the

science underlying civil infrastructure technology;

- $2.00 million for the funding of a network of nanofabrication centers in collaboration with the Engineering Activity; and
- $2.00 million for the funding of large scale instrumentation such as synchrotron beamlines in partnership with the Biosciences and Geosciences Activities.

Other Increases:

- $24.00 million increase for the Major Research Equipment Subactivity for a total of $72.00 million. This will keep funding for the High Magnetic Field Laboratory ($12.00 million) and the Gemini 8-Meter Telescopes ($17.00 million) on schedule. The Laser Interferometer Gravitational Wave Observatory (LIGO) ($43.00 million) will also remain on schedule, pending possible FY 1993 reprogramming actions discussed under the Major Research Equipment section; (see below also)
- $2.00 million increase for the Physics Subactivity to enhance the luminosity of the Cornell Electron Storage Ring;
- Incremental funding of $1.80 million for the National Astronomy Centers to address requirements for operations and maintenance with particular attention to infrastructure repair.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Mathematical Sciences	$84.95	$82.09	$ -2.86
Astronomical Sciences	120.00	110.64	-9.36
Physics	148.57	137.90	-10.67
Chemistry	125.95	122.25	-3.70
Materials Research	167.49	159.55	-7.94
Major Research Equipment	79.00	48.00	-31.00
	--------	--------	--------
Total, Subactivity	$725.96	$660.43	$-65.53

The FY 1993 Revised Current Plan is $660.43 million, a decrease of $65.54 million, or 9.0 percent, from the FY 1993 Request. The change is due to unspecified Congressional reductions and will result in fewer awards being made. The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993 which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request". All Subactivities are reduced. The Revised Current Plan represents an increase of $38.10 million over FY 1992.

The largest decrease, in the Major Research Equipment Subactivity, is in the funding for LIGO. A total of $48 million was requested and $20.00 million is included in the FY 1993 Revised Current Plan. Based on continued satisfactory progress, NSF may reprogram up to an additional $8.0 million in FY 1993, thereby increasing the total amount available in FY 1993 to $28.0 million. NSF will apprise Congress of pending changes in late spring or early summer 1993.

MATHEMATICAL SCIENCES: $88,010,000

The Mathematical Sciences Subactivity fosters the creation and development of mathematical ideas, methods and techniques; supports their synergistic interaction with theory and practice in the physical, biological, engineering and social sciences; and encourages their diffusion into the infrastructure base for education and human resource development and for technology. The National Science Foundation provides approximately 60 percent of the total Federal support for basic research in the mathematical sciences.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Research Project Support	$64.03	$68.71	$66.02	$69.94	$3.92
Special Projects	14.39	16.24	16.07	18.07	2.00
	--------	--------	--------	--------	--------
Total, Subactivity	$78.42	$84.95	$82.09	$88.01	$5.92

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Mathematical Sciences is $88.01 million, an increase of $5.92 million or 7.2 percent above the FY 1993 Current Plan of $82.09 million. Increased support for FCCSET initiatives in Advanced Materials and Processing (AMPP), Biotechnology, Global Change, High Performance Computing and Communications (HPCC), Manufacturing, and Mathematics and Science Education (M&SE) totals $5.72 million.

Explanation of Increases:

Mathematical Sciences Research Project Support increases by $3.92 million, or 5.9 percent, providing:

- $500,000 to initiate participation in Global Change research;
- $1.08 million for increased support of HPCC. Research in the development of algorithms, computational complexity, parallel computing, visualization and presentation of data will be highlighted;
- $1.44 million for increased support of theory, modeling and simulation in the AMPP, Manufacturing, and Biotechnology initiatives.

Special Projects increases by $2.0 million, or 12.4 percent, providing:

- Continuing infrastructure support of the disciplinary research community including undergraduate, graduate and postdoctoral training opportunities, support for national research institutes, and medium-scale scientific equipment; and

- Significant expansion of activities designed to link research and education managed in collaboration with the Education and Human Resources Activity.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Research Project Support	$68.71	$66.02	$ -2.69
Special Projects	16.24	16.07	-0.17
	--------	--------	--------
Total, Subactivity	$84.95	$82.09	$-2.86

The FY 1993 Revised Current Plan is $82.09 million, a decrease of $2.86 million (3.4 percent) from the FY 1993 Budget Request due to Congressional reductions. It represents an increase of $3.67 million, or 4.7 percent, over FY 1992.

CHANGES IN BUDGET STRUCTURE

The Mathematical Sciences Subactivity has been restructured into two program elements in order to simplify the budget presentation. A crosswalk of the FY 1993 Revised Current Plan for this new organization is shown below.

(Millions of Dollars)

Old Program Elements	New Program Elements		Total
	Research Project Support	Special Projects	
Disciplinary Research in Mathematics	50.02		50.02
Cross-Disciplinary and Computational Research in Mathematics	16.00		16.00
Special Projects		16.07	16.07
Total, Subactivity	66.02	16.07	82.09

ASTRONOMICAL SCIENCES: $113,940,000

NSF is the lead Federal agency for ground-based astronomy, providing about two-thirds of the Federal support for this area of science. Support is provided to individual investigators for ground-based research in all areas of astronomy. National Astronomy Centers provide observing capability in radio and optical/infrared regimes.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Research Project Support	$37.96	$41.64	$39.28	$40.78	$1.50
National Centers	74.26	78.36	71.36	73.16	1.80
	--------	--------	--------	--------	--------
Total, Subactivity	$112.22	$120.00	$110.64	$113.94	$3.30

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Astronomical Sciences in $113.94 million, an increase of $3.30 million or 3.0 percent above the FY 1993 Revised Current Plan of $110.64. Increased support for FCCSET initiatives in High Performance Computing and Communications (HPCC) and Mathematics and Science Education (M&SE) totals $1.50 million.

Explanation of Increases:

- $500,000 increase for HPCC is spread across both Research Project Support and National Centers. It includes support for development of advanced algorithms and software for complex, multi-dimensional modeling and enhanced network support for transfer of databases and remote control of observations.

- $1.00 million increase for M&SE will allow enhanced research opportunities for undergraduate students and faculty through individual investigator grants and through the National Centers.

Research Project Support increases $1.50 million or 3.8 percent, providing:

- $500,000 for development of adaptive optics systems for moderate-aperture (3- to 4- meter) telescope and for development of optical interferometers

in addition to the increased initiative funding described above.

National Centers increases by $1.80 million or 2.5 percent. The impact on the individual centers is as follows:

- $720,000 decrease for the National Astronomy and Ionosphere Center (NAIC), or 7.4 percent, to a total of $9.07 million. Within this total, $3.92 million will complete a major upgrade of the 305-meter telescope to increase significantly its sensitivity and scientific capabilities. The upgrade, cost-shared with NASA, is estimated at $23 million total. Modest increases for NAIC operation and management include improvements to instrumentation.

- $1.26 million increase for the National Optical Astronomy Observatory (NOAO), or 4.2 percent, to a total of $31.21 million. The increase will be focused on operations and maintenance of these optical and infrared observatories, with particular emphasis on infrastructure support.
- $1.26 million increase for the National Radio Astronomy Observatory (NRAO) to a total of $32.88 million. The increase will focus on operation and maintenance of existing telescopes, including repair of deteriorating infrastructure, associated instrumentation and computational support, and enhanced operations at the Very Long Baseline Array.

The table below provides more detail for the National Centers.

(Millions of Dollars)

	FY 1993 Estimate	FY 1994 Estimate
National Astronomy and Ionosphere Center		
Scientific Research Support*	$ 6.93	$ 7.47
Arecibo Upgrade	5.21	3.92
Less NASA Support	(2.35)	(2.32)
Total, NAIC	9.79	9.07
National Optical Astronomy Observatory		
Scientific Research Support*	$30.15	$31.41
[Kitt Peak National Observatory	9.51	10.11]
[Cerro Tololo Inter-American Observatory ..	7.23	7.73]
[National Solar Observatory	6.20	6.36]
Management Fee	0.47	0.67
Less DoD Support	(0.67)	(0.67)
Total, NOAO	29.95	31.21
National Radio Astronomy Observatory		
Scientific Research Support*	31.05	32.31
Management Fee	0.57	0.57
Total, NRAO	$ 31.62	$32.88

* Includes funds for operations and maintenance.

Construction of two 8-meter optical/infrared telescopes will continue under the auspices of NOAO with funds requested under the Major Research Equipment Subactivity. NRAO is currently constructing the new Green Bank Telescope, a 100 meter-class-, fully-steerable antenna. Construction will proceed in 1993 with funds made available in previous years through the Major Research Equipment Subactivity. Completion is anticipated in 1995.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Research Project Support	$41.64	$39.28	$ -2.36
National Centers	78.36	71.36	-7.00
	--------	--------	--------
Total, Subactivity	$120.00	$110.64	$-9.36

The FY 1993 Revised Current Plan is $110.64 million, a decrease of $9.36 million or 7.8 percent from the FY 1993 Budget Request due to unspecified Congressional reductions. It is a decrease of $1.58 million or 1.4 percent from the FY 1992 level.

CHANGES IN BUDGET STRUCTURE

The Astronomical Sciences Subactivity has been restructured into two program elements, in order to simplify the budgetary presentation. A crosswalk of the FY 1993 Revised Current Plan for this new organization is shown below.

(Millions of Dollars)

	New Program Elements		
Old Program Elements	Research Project Support	National Centers	Total
Astronomy Project Support	$39.28		$39.28
National Astronomy and Ionosphere Center		9.79	9.79
National Optical Astronomy Observatories		29.95	29.95
National Radio Astronomy Observatory		31.62	31.62
Total, Subactivity	$39.28	$71.36	$110.64

PHYSICS: $142,600,000

The National Science Foundation provides slightly under 50 percent of the total Federal support for basic research in physics at universities. This varies considerably by subdiscipline, with NSF providing about one-third and one-half of the support for elementary particle and nuclear physics, respectively, and essentially the entire Federal support of ground-based gravitational physics.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Research Project Support	$102.29	$108.77	$104.15	$106.85	$2.70
Facilities	35.78	39.80	33.75	35.75	2.00
Total, Subactivity	$138.07	$148.57	$137.90	$142.60	$4.70

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Physics is $142.60 million, an increase of $4.70 million or 3.4 percent above the FY 1993 Current Plan of $137.90 million. Increased support for FCCSET initiatives in Advanced Materials and Processing (AMPP), Biotechnology, High Performance Computing and Communications (HPCC), Manufacturing, and Mathematics and Science Education (M&SE) totals $4.7 million.

Explanation of Incraasas:

Physics Research Project Support increases by $2.70 million or 2.6 percent. Within the total of $106.85 million, shifts of emphasis provide:

- $1.00 million increase for High Performance Computing and Communications to explore approaches to advanced problem solving in parallel computing;
- $1.20 million increase for Advanced Materials and Processing, Manufacturing, and Environmental Sciences to investigate the characteristics of materials irradiated with ultra-high power laser light of extremely short duration, the science of nanolithography using light forces acting on atomic beams, and environmental matters; and
- $1.50 million increase to strengthen research activities of undergraduate students and faculty at many colleges and universities around the nation.

Support for Physics Facilities increases by $2.00 million or 6.2 percent. Within the $35.75 million total, shifts in emphasis will provide:

- $2.00 million increase for improving the luminosity of the Cornell Electron Storage Ring; and
- $1.10 million for development of compact superconducting cyclotrons, improving the quality of materials in superconducting accelerator applications, and enhancing data processing and communication in conjunction with FCCSET initiatives in Biotechnology, AMPP and HPCC.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Research Project Support	$108.77	$104.15	$ -4.62
Facilities	39.80	33.75	-6.05
Total, Subactivity	$148.57	$137.90	$-10.67

The FY 1993 Revised Current Plan is $137.90 million, a decrease of $10.67 million (7.2 percent) from the FY 1993 Budget Request, due to Congressional reductions. The Revised Current Plan represents a decrease of 0.17 million (0.1 percent) from the FY 1992 level. The FY 1993 Revised Current Plan reflects an emphasis on individual investigator and small group projects, increased participation in selected FCCSET initiatives, and LIGO R&D at the Congressionally mandated level of $5.00 million.

Support for research in gravitational physics leading to the Laser Interferometer Gravitational Wave Observatory (LIGO) is provided through the Physics Subactivity. However, funds for LIGO development and construction are included within the MPS Major Research Equipment Subactivity.

CHANGES IN BUDGET STRUCTURE

The Physics Subactivity has been restructured into two program elements, in order to simplify the budgetary presentation. The Facilities Program Element includes major, university-based accelerator facilities at Cornell University, at Michigan State University, and at Indiana University. A crosswalk of the FY 1993 Revised Current Plan for this new presentation is shown below.

(Millions of Dollars)

Old Program Elements	New Program Elements		Total
	Research Project Support	Facilities	
Elemantary Particle Physics	$27.21	$16.27	$43.48
Nuclear Sciences	25.79	17.48	43.27
Atomic, Molecular, and Optical Physics	19.99		19.99
Theoretical Physics	20.09		20.09
Gravitational Physics	11.07		11.07
Total, Subactivity	$104.15	$33.75	$137.90

CHEMISTRY: $130,890,000

The National Science Foundation provides approximately 23 percent of the total Federal support for research and development in chemistry, and 40 percent of Federal support for chemistry research in academic institutions. The Chemistry Subactivity not only provides research project support in all areas of chemistry, including materials, biological and environmental chemistry, but also special research education opportunities for undergraduate students and postdoctoral fellows, and nearly one-half of total Federal support for major chemistry research equipment facilities.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Research Project Support	$95.49	$104.48	$105.36	$111.50	$6.14
Instrumentation & Infrastructure	16.62	21.47	16.89	19.39	2.50
	--------	--------	--------	--------	--------
Totel, Subactivity	$112.11	$125.95	$122.25	$130.89	$8.64

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Chemistry is $130.89 million, an increase of $8.64 million or 7.1 percent above the FY 1993 Current Plan of $122.25 million. Increased support for FCCSET initiatives in Advanced Materials, Biotechnology, Global Change, High Performance Computing, Manufacturing, and Math and Science Education totals $5.10 million.

Explanation of Increases:

Research Project Support increases by $6.14 million, or 5.8 percent, providing:

- $1.20 million for the FCCSET Advanced Materials and Processing Program (AMPP). Focal points will include optical, electronic and biomolecular materials, especially collaborative projects linking chemists to engineers, materials scientists, and private sector partners.
- A $1.20 million increment in the High Performance Computing and Communications (HPCC) FCCSET initiative. Projects in development of advanced software and algorithms for complex, multi-dimensional modeling and analysis of supramolecular structure will be highlighted.
- $2.24 million for advanced research in environmental chemistry -- building on Chemistry's new program in "environmentally benign chemical manufacturing." Emphasis areas will include new catalytic processes to reduce waste production, simulation of environmental kinetics, light-induced chemical reactions in the biosphere, and new separation and detection methods.

- An increment of $600,000 for the FCCSET Biotechnology initiative. Chemistry opportunities for new knowledge and technology are high in areas such as bioprocessing, bioelectronics and biosensors, and marine natural products.

- $400,000 for the new FCCSET initiative in Advanced Manufacturing will target the science base of tomorrow's chemical manufacturing -- chemical synthesis for recyclability and waste minimization, in situ monitoring techniques, and ultrafast measurement technology.

Support for Instrumentation and Infrastructure increases $2.50 million, or 14.8 percent, providing:

- $1.00 million for next-generation instrumentation and facilities in the chemical sciences, such as nuclear magnetic resonance, ion cyclotron resonance, mass spectrometers, and synchrotron beam lines.

- $1.50 million to strengthen Chemistry's educational infrastructure, including enhancement of the national network of sites Research Experiences for Undergraduates and expansion of Postdoctoral Fellowship opportunities in interdisciplinary areas such as biological, materials, and environmental chemistry.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Research Project Support	$104.48	$105.36	$ 0.88
Instrumentation and Infrastructure	21.47	16.89	-4.58
	--------	--------	--------
Total, Subactivity	$125.95	$122.25	$-3.70

The FY 1993 Revised Current Plan is $122.25 million, a decrease of $3.70 million or 2.9 percent from the FY 1993 Budget Request, due to Congressional Reductions. The FY 1993 Revised Current Plan represents an increase of $10.14 million or 9.0 percent over the FY 1992 level.

The modest increase above the Request level in Research Project Support reflects emphasis on full implementation of the Chemistry component of FCCSET initiative research, and opportunities in environmental chemistry. Smaller than requested increases in Instrumentation and Infrastructure support result from priority on planned FCCSET research activities rather than on instrumentation, and deferral of some increases in the already strong Research Experiences for Undergraduates Program.

CHANGES IN BUDGET STRUCTURE

The Chemistry Subactivity has been restructured into two program elements to simplify the budgetary presentation. Research Project Support includes all individual and group research projects, including those within the FCCSET initiatives. Instrumentation and Infrastructure includes awards supporting shared instrumentation facilities, two Science and Technology Centers, and Human Resource Development programs, including Research Experiences for Undergraduates and Postdoctoral Fellowships. A Crosswalk of the FY 1993 Revised Current Plan for the new organization is shown below.

(Millions of Dollars)

Old Program Elements	New Program Elements		Total
	Research Project Support	Instrumentation & Infrastructure	
Chemical Instrumentation		$6.22	$6.22
Organic and Macromolecular Chemistry	29.47		29.47
Physical Chemistry	35.87		35.87
Inorganic, Bioinorganic & Organometallic Chemistry	19.48		19.48
Analytical & Surface Chemistry	15.54		15.54
Special Projects	5.00	10.67	15.67
Total, Subactivity	$105.36	$16.89	$122.25

MATERIALS RESEARCH: $170,950,000

The Materials Research Subactivity supports research to advance the fundamental understanding of the physics and chemistry of materials, to promote the development of new materials with novel or superior properties, and to further the understanding of interrelationships among synthesis and processing, structure and composition, properties, and performance of materials at molecular, microscopic, and macroscopic levels. The Subactivity provides approximately 50 percent of the total Federal support for university-based research in materials. Approximately half of this support is for individual investigators and small groups. The remainder supports centers and groups, major instrumentation, and large user facilities.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Materials Research Project Support	$77.73	$96.35	$87.71	$92.41	$4.70
Materials Research Centers and Groups	48.07	51.44	52.94	56.44	3.50
National Facilities & Instrumentation	17.74	19.70	18.90	22.10	3.20
	--------	--------	--------	--------	--------
Total, Subactivity	$143.54	$167.49	$159.55	$170.95	$11.40

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Materials Research is $170.95, an increase of $11.40 million or 7.1 percent above the FY 1993 Current Plan of $159.55 million. Increased support for FCCSET initiatives in Advanced Materials and Processing (AMPP), Biotechnology, Global Change, High Performance Computing and Communications (HPCC), Manufacturing, and Mathematics and Science Education totals $8.40 million.

Explanation of Increases:

- The Materials Research Subactivity plays a lead role in the AMPP program, with its focus on support for research involving new approaches to the synthesis, processing, preparation, and characterization of materials with new, unique, or superior properties. Linking the goals of this central FCCSET initiative with those of the others is an emphasis for the Materials Research Subactivity across all its programs.

Materials Research Project Support increases by $4.70 million, or 5.4 percent, providing:

- Resources for developing new and essential scientific and engineering knowledge for technological advances. These are critically dependent on the synthesis and processing of novel and advanced materials.

Materials Research Centers and Groups increases by $3.50 million, or 6.6 percent, providing:

- Resources to enable NSF to establish new Materials Reseach Centers and Groups (MRCGs). The MRCGs will provide support for interdisciplinary research and education in strategic areas of materials, strengthening the technology and human resource base in materials and their applications and forging strong links with industry and other sectors.

National Facilities and Instrumentation increases by $3.20 million, or 16.9 percent, providing:

- Establishment, in collaboration with the Engineering Activity, of a national nanofabrication users facility network.

- Construction of at least one synchrotron radiation beamline and the acquisition of other major instrumentation for materials research.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Materials Research Project Support	$96.35	$87.71	$ -8.64
Materials Research Centers and Groups	51.44	52.94	1.50
National Facilities & Instrumentation	19.70	18.90	-0.80
	--------	--------	--------
Total, Subactivity	$167.49	$159.55	$-7.94

The FY 1993 Revised Current Plan is $159.55 million, a decrease of $7.94 million (4.7 percent) from the FY 1993 Budget Request, due to Congressional reductions. The Revised Current Plan represents an increase of $16.01 million (11.2 percent) over the FY 1992 level. The increase in the Materials Research Centers and Groups program element reflects enhanced support of Materials Research Groups in response to strong demand from the community.

CHANGES IN BUDGET STRUCTURE

The name of the Materials Research Laboratories and Groups program element has been changed to Materials Research Centers and Groups, reflecting the Materials Research Subactivity's commitment to addressing interdisciplinary, university-based research groups, centers and laboratories as a continuum of activity rather than as separate competitions. There is no movement of funds between program elements, only a change in name.

MAJOR RESEARCH EQUIPMENT: $72,000,000

The National Science Foundation has long been a source of support for unique national research facilities. This investment has served dual purposes: it has stimulated technological development in meeting the requirements of forefront scientific research, while providing access to the tools needed by the community.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Major Research Equipment	$37.97	$79.00	$48.00	$72.00	$24.00
	--------	--------	--------	-------	--------
Total, Subactivity	$37.97	79.00	$48.00	$72.00	$24.00

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Major Research Equipment is $72.00 million, an increase of $24.00 million or 50.0 percent above the FY 1993 Revised Current Plan of $48.00 million.

Explanation of Increases:

Three projects make up the Major Research Equipment Subactivity: The National High Magnetic Field Laboratory (HMFL) at Florida State University, the Gemini 8-meter Optical/Infrared Telescopes (GEMINI) in Hawaii and Chile, and the Laser Interferometer Gravitational Wave Observatory (LIGO) being built by the California Institute of Technology. The HMFL is part of the Advanced Materials and Processing Program.

The increase of $24.00 million provides:

- $ 2.00 million decrease to a total of $12.00 million for the HMFL. This returns funding to the original profile. Full operation for the HMFL is planned for 1994, following a total expenditure of $140.00 million, more than half of which is provided by the State of Florida.

- $ 3.00 million increase to a total of $17.00 million for GEMINI, the international partnership building telescopes in the northern and southern hemispheres. Construction begins in FY 1994. Total costs are planned at $176.00 million, with NSF providing one-half, or $ 88.00 million on behalf of the U.S.

- $23.00 million increase to a total of $43.00 million for LIGO. The planned level of continuing funding for LIGO is $50.00 million per year. Pending possible reprogramming in FY 1993 (see below), the FY 1994 Request level will allow for completion of construction by 1998 at a total cost of $229.10 million.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Major Research Equipment	$79.00	$48.00	$ -31.00
	--------	--------	--------
Total, Subactivity	$79.00	$48.00	$-31.00

The FY 1993 Revised Current Plan is $ 48.00 million, a decrease of $31.00 million or 39.2 percent from the FY 1993 Budget Request due to Congressional reductions. The FY 1993 Revised Current Plan represents an increase of $10.00 million or 26.4 percent over the FY 1992 level.

- The HMFL is maintained at the planned level of $14.00 million in accordance with NSF's partnership with the State of Florida.

- $3.00 million decrease from the FY 1993 request for GEMINI to a total of $14.00 million due to delays in establishing full details of the international partnership.

- $28.00 million decrease for LIGO to a total of $20.00 million. Pending satisfactory progress, NSF may reprogram up to an additional $8.00 million in FY 1993, thereby increasing the total amount available in FY 1993 to $28.00 million. NSF will apprise Congress of pending changes in late spring or early summer 1993.

SOCIAL, BEHAVIORAL & ECONOMIC SCIENCES: $106,910,000

Within the Social, Behavioral and Economic Sciences (SBE) Activity the Foundation supports activities that build fundamental knowledge about human characteristics and behavior, including improved understanding of science itself. SBE also supports the Foundation's international activities, providing access to centers of excellence in science and engineering education and research throughout the world. To improve the understanding of science and engineering, SBE provides tools for tracking, assessing, and managing the resources vital to building the nation's science and engineering infrastructure, both human and institutional.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change Amount	Change Pcnt
Social, Behavioral and Economic Research ...	$65.99	$ 78.36	$70.35	$ 75.31	$4.96	7.1
International Cooperative Scientific Activities .	13.11	14.90	15.92	18.92	3.00	18.8
Science Resources Studies	6.89	14.53	12.68	12.68	0.00	0.0
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Total, Activity	$85.99	$107.79	$98.95	$106.91	$7.96	8.0

FY 1994 BUDGET REQUEST

The SBE Activity increases by $7.96 million over the FY 1993 Revised Current Plan, to a total of $106.91 million. The level funding of the Science Resources Studies Subactivity is due to the completion of projects in FY 1993 which will make sufficient funds available in FY 1994.

NSF and Interagency Initiatives

This request provides support for SBE's increased participation in three initiatives coordinated by the Federal Coordinating Council for Science, Engineering and Technology (FCCSET), with most Subactivities contributing to FCCSET initiative support. The following table displays SBE's funding level for these initiatives. The remaining initiatives will receive level funding to maintain current participation.

(Millions of Dollars)

Initiative *	FY 1993 Estimate	FY 1994 Estimate	Change FY 1994 vs. FY 1993
High Performance Computing & Communications	0.75	1.10	0.35
Advanced Manufacturing	4.00	4.40	0.40
Math & Science Education	3.24	3.59	0.35

* some awards are counted toward more than one initiative

The FCCSET initiatives displayed in the above table increase a total of $1.10 million and consist of support for the following research and educational activities:

- $400,000 increase in the Advanced Manufacturing initiative for analyses of effective models for managing technological innovation, and on the dissemination of the models.
- $350,000 increase in High Performance Computing and Communication for a program to understand and improve the ability of people to handle complex information.
- $350,000 increase in Math and Science Education for research on urban education, in collaboration with the Urban Systemic Initiative of the Foundation.

Other Increases:

- $2.00 million to increase award sizes across research programs to enhance the ability of researchers to conduct world-class research.
- $400,000 increase for research in cooperation with the Directorate for Engineering targeted to the rebuilding of the civil infrastructure of the U.S. SBE will highlight analyses of the economic returns from investments in the infrastructure and on the political and legal contexts that facilitate reconstruction.
- $1.46 million for the Intelligent Systems Initiative, for programs to strengthen the teaching of cognitive skills in mathematics and science, and for the development of automated systems at the leading edge.
- $3.00 million for International Programs to strengthen the Foundation's ability to support international cooperative research experiences for scientists and engineers early in their careers, and strengthen cooperative programs with Eastern Europe and the former Soviet Union and with developing nations in Africa, Latin America and Asia.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Social, Behavioral and Economic Research .	$ 78.36	$70.35	$-8.01
International Cooperative Scientific Activities	14.90	15.92	1.02
Science Resources Studies	14.53	12.68	-1.85
	--------	--------	--------
Total, Subactivity	$107.79	$98.95	$-8.84

The FY 1993 Revised Current Plan is $98.95 million, a decrease of $8.84 million, or 8.2 percent, from the FY 1993 Request. The change is due to unspecified Congressional reductions and will result in fewer awards being made. The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993 which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The Revised Current Plan reduction is reflected primarily in the Social, Behavioral and Economic Research Subactivity, where research initiatives are limited to small scale planning activities, and research support continues below fully enabling levels. In addition, SRS delayed some analytical and evaluation activities until FY 1994. INT received increased funding in part, to support programs in Eastern Europe and the former Soviet Union.

SOCIAL, BEHAVIORAL AND ECONOMIC RESEARCH: $75,310,000

The National Science Foundation provides the majority of total federal support for basic research in the social, behavioral, and economic sciences. This research addresses all aspects of human behavior, interaction, and decision making, as well as social and economic systems, organizations and institutions. Support is also provided to improve the quality and accessibility of social and economic data resources and collections.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Economic, Decision and Management Sciences	$21.48	$25.98	$22.31	$23.72	$1.41
Social and Political Sciences	14.56	18.35	16.14	17.34	1.20
Anthropological and Geographic Sciences	13.50	15.03	14.03	14.73	0.70
Cognitive, Psychological and Language Sciences	12.75	14.64	13.26	14.66	1.40
Science, Technology and Society	3.70	4.36	4.61	4.86	0.25
Total, Subactivity	$65.99	$78.36	$70.35	$75.31	$4.96

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Social, Behavioral and Economic Research is $75.31 million, an increase of $4.96 million or 7 percent above the FY 1993 Revised Current Plan of $70.35 million.

Explanation of Increases:

- $1.46 million for expansion of the Intelligent Systems Initiative to support interdisciplinary research and training. Research will be expanded to address human abilities to receive, process, store, and communicate information and to interact with artificial systems designed to deal with massive volumes of information.
- $1.10 million for increased support of FCCSET initiatives on High Performance Computing and Communications, Advanced Manufacturing, and Math and Science Education.
- $400,000 to support social science research in a new strategic initiative on Civil Infrastructure.
- $2.00 million to increase the size of awards across all programs so as to better enable researchers to conduct world-class research.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Economic, Decision and Management Sciences	$25.98	$22.31	$-3.67
Social and Political Sciences	18.35	16.14	-2.21
Anthropological and Geographic Sciences	15.03	14.03	-1.00
Cognitive, Psychological and Language Sciences	14.64	13.26	-1.38
Science, Technology and Society	4.36	4.61	0.25
	--------	--------	--------
Total, Subactivity	$78.36	$70.35	$-8.01

The FY 1993 Revised Current Plan is $70.35 million, a decrease of $8.01 million (10.2 percent) from the FY 1993 Budget Request. The decrease is due to unspecified Congressional reductions, and will result in fewer awards being made. The increase in the Science, Technology and Society program element is due to the inclusion of a new effort on Research on Science and Technology.

INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES: $18,920,000

The International Cooperative Scientific Activities (INT) Subactivity invests in people by promoting partnerships between U.S. and foreign scientists with the aim of enhancing access to critical research conducted outside the United States and increasing knowledge of mutually beneficial opportunities abroad. These programs support the exploratory phases of international research collaborations, workshops, and studies which aim to establish significant, long-term cooperative research relationships that can augment U.S. science and engineering capabilities; invest in people, particularly by enhancing the international perspectives of the next generation of U.S. scientists and engineers through research participation, fellowships, and summer programs; and stimulate cooperation in geographical regions where research activities are difficult to undertake.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
International Cooperative Scientific Activities	$13.11	$14.90	$15.92	$18.92	$3.00
	--------	--------	--------	--------	--------
Total, Subactivity	$13.11	$14.90	$15.92	$18.92	$3.00

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for International Cooperative Scientific Activities is $18.92 million, an increase of $3.00 million or 18.8 percent above the FY 1993 Revised Current Plan of $15.92 million.

Explanation of Increases:

- expand human resource development through providing opportunities for scientists and engineers in the early stages of their careers to become involved in international cooperative research projects, and augment existing postdoctoral and junior faculty fellowship programs by expanding the number of awards and increasing the maximum length of time from one to two years; and

- expand cooperative programs with Eastern Europe and the former Soviet Union, promoting new partnerships between centers of excellence and scientific organizations in the U.S. and in these regions, enhancing their scientific infrastructure, and sharing U.S. experience in research management as a long-term investment in integrating this region into the global scientific enterprise; and

- expand interactions with developing countries, by means of catalyzing center-to-center linkages and by encouraging the establishment of networks in critical research areas in these regions, where research is relatively difficult to initiate, and where opportunities to establish long-term partnerships have been relatively neglected by U.S. investigators.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
International Cooperative Scientific Activities	$14.90	$15.92	$1.02
	--------	--------	--------
Total, Subactivity	$14.90	$15.92	$1.02

The FY 1993 Revised Current Plan is $15.92 million, an increase of $1.02 over the FY 1993 Request of $14.90 million. The Revised Current Plan has made possible modest increases for human resource development and infrastructure support programs for Eastern Europe and the former Soviet Union, and has supported the pilot phases of projects linking science and technology centers in the U.S. with comparable centers abroad. It has also permitted INT to continue to provide support for international collaborative research projects involving U.S. scientists and engineers and foreign colleagues throughout the world at approximately the same level as in FY 1992.

SCIENCE RESOURCES STUDIES: $12,680,000

The Science Resource Studies program collects, analyzes, and disseminates data on domestic and international resources devoted to science and technology. This information is crucial to NSF and other Federal policy-makers concerned with the health of the nation's science and technological enterprise. The program is the primary source of statistics on: scientific and technical personnel, including employment and other characteristics of scientists and engineers, with emphasis on women and minorities, including projections of supply and demand for these personnel; education, with emphasis on undergraduate and graduate areas; research and development activities, including financial and infrastructure resources; and indicators of national and international science and engineering impacts.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Studies in Science and Engineering Resources	$6.89	$14.53	$12.68	$12.68	$0.00
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Total, Subactivity	$6.89	$14.53	$12.68	$12.68	$0.00

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Science Resources Studies is $12.68 million which includes internal redistributions, but is unchanged from the FY 1993 Revised Current Plan.

Explanation of Radistribution:

- Funding for the National Survey of College Graduates declines by $1.63 million, as most of the data collection effort occurs in FY 1993. Follow-up operations will be done in FY 1994 to ensure a high response rate, complete the bulk of the data processing operations, and analyze the data. The other major changes include:
- $600,000 for a survey of industrial innovation, designed to better understand this nation's process of innovation in relation to that in other industrial countries
- $439,000 for analysis of new data on scientific and engineering personnel
- $90,000 for improvement of surveys of facilities and of research funding that will improve utility to policy-makers and reduce respondents' burden
- $200,000 for publication costs for Science and Engineering Indicators.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Studies in Science and Engineering Resources	$14.53	$12.68	$-1.85
	--------	--------	--------
Total, Subactivity	$14.53	$12.68	$-1.85

The FY 1993 Revised Current Plan is $12.68 million, a decrease of $1.85 million (13 percent) from the FY 1993 Budget Request. The decrease from the FY 1993 request, due to unspecified Congressional reductions, caused some analytical and evaluation activities to be delayed to ensure data collection for Congressionally mandated reports.

EDUCATION & HUMAN RESOURCES: $556,100,000

The responsibility of the Education and Human Resources (EHR) Activity is to define and fund programs and projects that support the educational aspects of the Foundation's mission. The present portfolio represents a cohesive and comprehensive set of activities which encompass every level of education, augmented by informal science experiences. These taken together ensure the production of a cadre of excellently trained scientists and engineers and a scientifically literate citizenry. EHR plays a major role in mathematics and science education, funding about thirty percent of the total federal effort in FY 1994.

(Millions of Dollars)

Subectivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan[*]	FY 1994 Request	Change	
					Amount	Pcnt
Systemic Reform[**]	$44.49	$76.00	$85.68	$102.98	$ 17.30	20.2
Elementary, Secondary and Informal Education	198.12	191.35	188.45	197.95	9.50	5.0
Undergraduate Education	60.66	63.00	61.74	74.84	13.10	21.2
Graduate Education and Research Development	55.60	57.90	62.46	66.46	4.00	6.4
Human Resource Development	46.28	50.10	48.89	65.89	17.00	34.8
Research, Evaluation and Dissemination	36.26	41.15	40.28	47.98	7.70	19.1
Total, Activity	$441.41	$479.50	$487.50	$556.10	$68.60	14.1

[*] Does not include additional $24.07 million unobligated balance from FY 1992.

[**] Includes EPSCoR beginning FY 1993.

FY 1994 BUDGET REQUEST

The EHR Activity increases by $68.60 million over the FY 1993 Revised Current Plan, to a total of $556.10 million.

Education Level and Interagency Initiatives:

This request provides support for EHR's participation in several FCCSET initiatives: significantly in the Math and Science Education Initiative ($509.81 million) with lesser participation in High Performance Computing and Communications ($12.92 million), Biotechnology ($10.30 million), and Advanced Materials ($7.10 million). Within these initiatives, support is broadly distributed across educational levels as shown in the following table.

(Millions of Dollars)

Education Level	FY 1993 Estimate*	FY 1994 Estimate	Change FY 1994 vs. FY 1993
Precollege	$309.22	$351.97	$42.75
Undergraduate	72.42	93.02	20.60
Graduate	54.79	58.79	4.00
Public Science Literacy	6.03	6.03	0.00
Math & Science Education Initiative	$442.46	$509.81	$67.35
Other**	45.04	46.29	1.25
Total, EHR	$487.50	$556.10	$68.60

* Does not include additional $24.07 million unobligated balance from FY 1992.

** Includes EPSCoR, programs for women faculty and minority institution research.

Participation in the FCCSET Math and Science Education initiative includes requested increases of:

- $17.30 million (20.2 percent) for Systemic Reform activities, including $14.00 million for a major expansion (to about eight cities) of the Urban Systemic Initiatives begun in FY 1993, $2.00 million primarily for technical assistance in the State Systemic Initiatives Program, and $1.30 million for NSF participation in the development of national science education standards at the K-12 level.

- $9.50 million (5.0 percent) in Elementary, Secondary and Informal Education, including $8.00 million devoted to the implementation of exemplary curricula, materials, and practices that have been developed with NSF support.

- $13.10 million (20.2 percent) for Undergraduate Subactivity, including expanded support for course, curriculum and laboratory development efforts ($4.50 million) and increased support for K-12 teacher preparation activities ($5.50 million).

- $4.60 million for initiation of efforts in technical education, included within growth provided at elementary/secondary and undergraduate levels. This initiative will be the joint responsibility of the Undergraduate Education Subactivity ($3.10 million) and the Elementary, Secondary and Informal Education Subactivity ($1.50 million).

- $4.00 million (6.4 percent) in the Graduate Education and Research Development Subactivity, primarily to support an increase in the Graduate Research Traineeships effort that Congress directed NSF to initiate.

- $17.00 million (34.8 percent) for Human Resource Development, including $7.50 million for a major expansion of targeted model and experimental projects for women and persons with disabilities, and $7.00 million for growth in project support for Alliances for Minority Participation. In addition, $2.50 million is provided for participation in the new cross-Foundation program, Model Institutions for Excellence (MIE). Approximately six awards will be supported, by EHR and Research and Related Activities, for selected minority institutions to serve as models for recruitment and retention of underrepresented students in science and engineering undergraduate programs.

- $7.70 million (19.1 percent) for Research, Evaluation and Dissemination. This includes $3.00 million for continued growth of evaluation activities within NSF and in support of evaluation efforts of the FCCSET Committee on Education and Human Resources, and $4.70 million for high performance computing and communications activities directed to establishment and/or enhancement of education networks.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Subactivity	FY 1993 Request	FY 1993 Revised Current Plan*	Change
Systemic Reform	$76.00	$85.68	$9.68
Elementary, Secondary and Informal Education	191.35	188.45	-2.90
Undergraduate Education	63.00	61.74	-1.26
Graduate Education and Research Development	57.90	62.46	4.56
Human Resource Development	50.10	48.89	-1.21
Research, Evaluation and Dissemination	41.15	40.28	-0.87
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Total, Subactivity	$479.50	$487.50	$8.00

* Does not include additional $24.07 million unobligated balance from FY 1992.

Increases in the Systemic Reform ($9.68 million) and Graduate Education and Research Development ($4.56) Subactivities are the result of Congressional mandates. Within Systemic Reform, $5.00 million were added for the Experimental Program to Stimulate Competitive Research (EPSCoR) and $5.00 million for initiative the Urban Systemic Initiatives Program. At the direction of Congress, $5.00 million were reprogrammed within EHR to fund a second class of Graduate Research Traineeships (GRT). These funds were reallocated to GERD.

All subactivities were reduced to accommodate a mandated $2 million general decrease. Elementary, Secondary and Informal Education (ESIE), Undergraduate Education (UE), Human Resource Development (HRD), and Research, Evaluation and Dissemination (RED) were reduced to reallocate the funds necessary for GRT.

FY 1992 Carryover funds totaling $24.07 million, not included in the above table, were distributed as follows:

- $22.80 million to GERD for initiation of the Graduate Research Traineeships,

- $273,000 to UE to fund additional projects which address directly underrepresentation and precollege teacher preparation,

- $300,000 to HRD to enhance support for projects for women and persons with disabilities, and

- $700,000 to RED for support of projects related to high performance computing and communications.

SYSTEMIC REFORM: $102,980,000

The Systemic Reform Subactivity supports state and local reform efforts to improve science, mathematics and engineering education and research. Two programs, Educational System Reform and Experimental Program to Stimulate Competitive Research (EPSCoR) comprise the major components of this Subactivity. These programs provide catalytic support for cooperative efforts to address fundamental, sustainable changes and infrastructure development in states and urban areas. Systemic Reform also supports activities to develop national standards for mathematics and science education.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change Amount	Change Pcnt
Educational System Reform	$44.49	$56.50	$61.26	$78.56	$ 17.30	28.2
Experimental Program to Stimulate Competitive Research*	[18.02]	19.50	24.42	24.42	0.00	0.0
Total, Subactivity	$44.49	$76.00	$85.68	$102.98	$17.30	20.2

* Includes EPSCoR beginning FY 1993.

FY 1994 BUDGET REQUEST

The Systemic Reform Subactivity increases by $17.30 million over the FY 1993 Revised Current Plan, to a total of $102.98 million.

Explanation of Increases:

Educational System Reform increases by $17.30 million, or 28.2 percent, to a total of $78.56 million. The major components of this increase are for the following initiatives:

- $14.00 million to the Urban Systemic Initiative (USI) for about five new awards, for a total of about eight awards to cities for projects designed to bring about systemic change in science, mathematics, and engineering education in large urban school systems.
- $2.00 million to the Statewide Systemic Initiatives (SSI) for technical assistance to aid SSI and other states to improve their capacity to make significant changes -- including teacher enhancement and leadership development. Continuing support is provided for approximately 25 ongoing SSI awards.
- $1.30 million to increase the support for the development of science standards, which are crucial to the reform efforts targeted at the K-12 level. These efforts complement work already accomplished on national standards for mathematics education.

EPSCoR is sustained at current levels after significant growth in FY 1993.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Educational System Reform	$56.50	61.26	$4.76
Experimental Program to Stimulate Competitive Research	19.50	24.42	4.92
Total, Subactivity	$76.00	$85 68	$9.68

The FY 1993 Revised Current Plan is $85.68 million, an increase of $9.68 million, or 12.7 percent, over the FY 1993 Budget Request due to Congressional mandates. The Revised Current Plan represents an increase of $41.19 million, or 92.6 percent, over the FY 1992 level.

The $4.76 million increase in the Revised FY 1993 Current Plan for Educational Reform includes $5.00 million for urban initiatives, as designated by Congress, together with adjustments mandated by the general reduction for all EHR Subactivities. The $4.92 million increase designated for EPSCoR (as adjusted) is directed to a competition for up to four awards, resulting in 18 to 19 states with improvement awards.

ELEMENTARY, SECONDARY AND INFORMAL EDUCATION: $197,950,000

The Elementary, Secondary & Informal Education (ESIE) Subactivity supports major programs in instructional materials development, teacher enhancement and recognition, informal science education, and student enrichment. Its goal is to enable **all** students (pre-kindergarten to grade 12) to succeed, and to increase the scientific literacy of students of all ages. Its programs will accelerate progress in attaining national education goals that set high levels of achievement, competency and literacy in science and mathematics. These efforts have a key leadership role in the FCCSET strategic plan for education and human resources.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change Amount	Change Pcnt
Student Support	$10.93	$11.00	$10.95	$11.00	$ 0.05	0.5
Curriculum Development	41.04	39.85	39.68	45.45	5.77	14.5
Teacher Enhancement and Development	111.65	105.50	102.97	106.50	3.53	3.4
Informal Science Education	34.50	35.00	34.85	35.00	0.15	0.4
Total, Subactivity	$198.12	$191.35	$188.45	$197.95	$9.50	5.0

FY 1994 BUDGET REQUEST

The Elementary, Secondary and Informal Education Subactivity increases by 9.50 million over the FY 1993 Revised Current Plan, to a total of $197.95 million.

Explanation of Increases:

Priority is given to Curriculum Development (increases by $5.77 million, or 14.5 percent) and Teacher Enhancement and Development (increases by $3.53 million, or 3.4 percent). Overall, the increase provides:

- $8.0 million to accelerate the implementation of exemplary curriculum and instructional materials developed by NSF. This will be accomplished through combined activities in instructional materials development and teacher enhancement.
- $1.5 million to expand opportunities for technology education within current programs. These activities will benefit technically-oriented students, preparing them for transition to the workplace or to post-secondary study at two- and four-year colleges. The Elementary, Secondary and Informal Education Subactivity effort will be closely coordinated with the Undergraduate Subactivity in the area of technical workforce training.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Student Support	$11.00	$10.95	$-0.05
Curriculum Development	39.85	39.68	-0.17
Teacher Enhancement and Development	105.50	102.97	-2.53
Informal Science Education	35.00	34.85	-0.15
Total, Subactivity	$191.35	$188.45	$-2.90

The FY 1993 Revised Current Plan is $188.45 million, a decrease of $2.90 million, or 1.5 percent, from the FY 1993 Budget Request to accommodate Congressional directives in other Subactivities. The Revised Current Plan represents a decrease of $9.67 million, or 4.9 percent, from the FY 1992 level, due to the shift of funds to support teacher enhancement activities in systemic reform efforts.

UNDERGRADUATE EDUCATION: $74,840,000

The Undergraduate Education Subactivity provides leadership and leveraged project support for technical colleges, two- and four-year colleges, and comprehensive and research universities. The programs seek to engage all undergraduate students in the learning of science--those who will be engineers and scientists or skilled technicians, teachers of science and mathematics, leaders of business, the professions, and government and citizens in an increasingly technology-based society. The focus is on reforming curricula and laboratories, upgrading instructional scientific equipment, enhancing college and university faculty and teaching, improving the undergraduate preparation of precollege teachers, and addressing advanced technician training.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change Amount	Change Pcnt
Curriculum and Laboratory Development	$40.81	$41.00	$40.83	$48.43	$ 7.60	18.6
Teacher and Faculty Development	19.85	22.00	20.91	26.41	5.50	26.3
Total, Subactivity	$60.66	$63.00	$61.74	$74.84	$13.10	21.2

FY 1994 BUDGET REQUEST

The Undergraduate Education Subactivity increases by $13.10 million over the FY 1993 Revised Current Plan, to a total of $74.84 million.

Explanation of Increases:

The requested increase emphasizes advanced technical workforce education and the preparation of future elementary and secondary teachers.

Curriculum and Laboratory Development increase of $7.60 million, or 18.6 percent, provides:

- $3.10 million to initiate efforts for advanced technical workforce education, through development and implementation of model curricula, materials, technologies, and laboratory improvements. Partnerships will be formed involving groups from among high schools, two-year colleges, four-year colleges, universities, and industry. The coordination of efforts at the collegiate and school levels will be achieved through close cooperation between the Undergraduate Education Subactivity and the Elementary, Secondary, and Informal Education Subactivity.

- $4.50 million to expand support for science, mathematics, and engineering laboratory development and the development of courses and curricula. Support will emphasize the high-priority freshman and sophomore courses and will encourage changes in the faculty culture leading to increased involvement of active scientists, mathematicians, and engineers in educational development. In addition, it will enable the beginning of systemic changes to selected undergraduate curricula at all levels.

Teacher and Faculty Development increase of $5.50 million, or 26.3 percent, provides:

- Enhanced scope of the Collaboratives for Excellence in Teacher Preparation program, by supporting incentives to attract and retain talented students, especially women, minorities and persons with disabilities, to careers in teaching. With this support, approximately 5 - 7 collaboratives will be awarded in addition to the three funded in FY 1993.
- Increased support of development and implementation of model science, mathematics, and technology curricula and laboratory improvements which target the preparation of teachers.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Curriculum and Laboratory Development	$41.00	40.83	$-0.17
Teacher and Faculty Development	22.00	20.91	-1.09
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Total, Subactivity	$63.00	$61.74	$-1.26

The FY 1993 Revised Current Plan is $61.74 million, a decrease of $1.26 million or 2.0 percent, from the FY 1993 Budget Request to accommodate Congressional directives in other Subactivities. The Revised Current Plan represents an increase of $1.08 million, or 1.8 percent, over the FY 1992 level.

GRADUATE EDUCATION & RESEARCH DEVELOPMENT: $66,460,000

The Graduate Education and Research Development (GERD) activity focuses on developing a diverse pool of individuals educated at the advanced levels of science and engineering to meet the educational, scientific and technological needs of the nation. To achieve this objective, GERD employs graduate fellowships and traineeships, and faculty development awards -- all highly leveraged activities designed to provide flexible support to meritorious individuals.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan*	FY 1994 Request	Change	
					Amount	Pcnt
Graduate Student Support	$50.22	$50.00	$54.79	$58.79	$ 4.00	7.3
Faculty Development	5.38	7.90	7.67	7.67	0.00	0.0
Total, Subactivity	$55.60	$57.90	$62.46	$66.46	$4.00	6.4

* Does not include additional $22.80 million unobligated balance from FY 1992 for graduate traineeships.

FY 1994 BUDGET REQUEST

The Graduate Education and Research Development Subactivity increases by $4.00 million over the FY 1993 Revised Current Plan, to a total of $66.46 million.

Explanation of Increases:

- $4 million increase in Graduate Student Support provides first year funding for about 180 new graduate research traineeship positions in areas of science and engineering critical to the economic competitiveness of the United States. This increase brings to approximately 580 the total number of traineeships supported, through awards to institutions.

Traineeships complement the Foundation's Graduate Fellowships, awarded to individuals. Over 2300 fellows will be supported in FY 1994.

Faculty Development, which is primarily aimed at advancement of women in science and engineering, will be sustained at FY 1993 levels. This will allow new awards through Visiting Professorships for Women and continued support through Faculty Awards for Women.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan*	Change
Graduate Student Support	$50.00	54.79	$4.79
Faculty Development	7.90	7.67	-0.23
Total, Subactivity	$57.90	$62.46	$4.56

* Does not include additional $22.80 million unobligated balance from FY 1992 for graduate traineeships.

The FY 1993 Revised Current Plan of $62.46 million is an increase of $4.56 million, or 7.9 percent, over the FY 1993 Budget Request. The increase is for a second group of graduate traineeships, in response to Congressional directives (as adjusted by the general reduction also mandated for all EHR Subactivities.)

An additional $22.80 million is carried over from FY 1992 to initiate the first class of traineeships. The competition was initiated in FY 1992, and the first awards were made in early FY 1993.

HUMAN RESOURCE DEVELOPMENT: $65,890,000

The Human Resource Development Subactivity (HRD) supports activities to increase the presence of minorities, women and persons with disabilities, in the scientific, technological, and educational enterprise. Efforts focus on a comprehensive set of activities that address new partnerships, institutional enhancements and model programs at all points along the science and engineering pipeline.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Precollege Education	$15.20	$13.89	$13.83	$13.83	$ 0.00	0.0
Undergraduate Student Support	16.52	20.10	19.01	26.01	7.00	36.8
Institutional Support	12.70	13.00	12.95	15.45	2.50	19.3
Model and Experimental Programs	1.86	3.11	3.10	10.60	7.50	241.9
Total, Subactivity	$46.28	$50.10	$48.89	$65.89	$17.00	34.8

FY 1994 BUDGET REQUEST

The Human Resource Development Subactivity increases by $17.00 million above the FY 1993 Revised Current Plan, to a total of $65.89 million.

Explanation of Increases

The major changes consist of the following:

- $7.0 million increase (36.8 percent) for the Undergraduate Student Support will provide five new Alliances for Minority Participation (AMP), for a total of twenty AMP awards. These projects establish partnerships between community colleges, 4-year colleges and universities, school systems, industry, community-based groups, and other science-based organizations. Each AMP project will at least double their current production of baccalaureate degrees awarded to underrepresented minority individuals in science, engineering, and mathematics disciplines within five years.
- $7.5 million increase for new Model and Experimental Programs, for the following two initiatives:
  - $5.0 million to establish comprehensive and systemic program for Women and Girls in Science (S&E). Activities in this program will focus on creating positive academic climates and removing barriers for females in their selection of careers in S&E.
  - $2.5 million to establish a comprehensive set of efforts to increase the participation of persons with disabilities in S&E. Activities will include mentoring via telecommunication and computer linkages, and teacher awareness training seminars.

- $2.5 million increase in Institutional Support will initiate the developmental and educational activities for minority institutions participating in the new Model Institutions for Excellence (MIE). MIE awards will serve as models for successful recruitment, academic enrichment, mentoring and retention, to increase the number baccalaureate degrees earned by minorities in mathematics, science and engineering. EHR participates with the research activities of the Foundation in this initiative, for which up to six awards are planned for FY 1994.

Precollege Education program element will be sustained at FY 1993 levels. The focus of precollege growth in FY 94 is through the expanded efforts in Model and Experimental Programs.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	**FY 1993 Request**	**FY 1993 Revised Current Plan**	**Change**
Precollege Education	$13.89	$13.83	$-0.06
Undergraduate Student Support	20.10	19.01	-1.09
Institutional Support	13.00	12.95	-0.05
Model and Experimental Programs	3.11	3.10	-0.01
Total, Subactivity	$50.10	$48.89	$-1.21

The FY 1993 Revised Current Plan is $48.89 million, a decrease of $1.21 million, or 2.4 percent, from the FY 1993 Budget Request to accommodate Congressional directives in other Subactivities. The Revised Current Plan represents an increase of $2.61 million, or 5.6 percent, over the FY 1992 level.

CHANGES IN BUDGET STRUCTURE

The accompanying crosswalk addresses the new program element, Model and Experimental Programs, that has been added to this Subactivity. Prior to the establishment of this element, projects for women and girls, and persons with disabilities, were funded within Precollege Education career access activities. Planning grants and small projects are supported in FY 1993. With major expansion in FY 1994, a separate program element is established for visibility and accountability.

FY 1993 Revised Current Plan
(Millions of Dollars)

New Program Elements	Old Program Elements			Total, Subactivity
	Precollege Education	Undergraduate Student Support	Institutional Support	
Precollege Education	$13.83			$13.83
Undergraduate Student Support		$19.01		19.01
Institutional Support			$12.95	12.95
Model and Experimental Programs	3.10			3.10
Total, Subactivity	$16.93	$19.01	$12.95	$48.89

RESEARCH, EVALUATION & DISSEMINATION: $47,980,000

The Research, Evaluation and Dissemination Subactivity supports research on factors that contribute to effective teaching and learning of mathematics, science and technology for all students. The Subactivity supports comprehensive evaluation and dissemination activities in order to identify effective science education strategies and help ensure their implementation. The Subactivity lays research foundations for applications of advanced technologies and promotes use of those technologies (including networking) to support systemic reform.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Research	$14.04	$15.25	$14.79	$14.79	$ 0.00	0.0
Evaluation	5.63	6.00	5.97	8.97	3.00	50.3
Dissemination and Technology Utilization	16.59	19.90	19.52	24.22	4.70	24.1
Total, Subactivity	$36.26	$41.15	$40.28	$47.98	$7.70	19.1

FY 1994 BUDGET REQUEST

The Research, Evaluation and Dissemination Subactivity increases by $7.70 million over the FY 1993 Revised Current Plan, to a total of $47.98 million.

Explanation of Increases

The requested increase indicates continued priority for program evaluation across the EHR Activity, as well as leadership in the evaluation of science education programs across federal agencies.

- $3.00 million increase (50.3 percent) in Evaluation will expand and enhance existing initiatives to evaluate all EHR programs on a systematic basis, and to continue leadership for evaluation activities in support of the strategic plan of the FCCSET Committee on Education and Human Resources.
- $4.70 million increase (24.1 percent) in Dissemination and Technology Utilization will augment participation in the High Performance Computing and Communication initiative. This will support linkages between SSI states and NREN service providers, as well as other activities to stimulate innovation in educational networking.

Research is sustained at the FY 1993 level.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change
Research	$15.25	$14.79	$-0.46
Evaluation	6.00	5.97	-0.03
Dissemination and Technology Utilization . .	19.90	19.52	-0.38
	-----------	-----------	-----------
Total, Subactivity	$41.15	$40.28	$-0.87

The FY 1993 Revised Current Plan is $40.28 million, a decrease of $870,000 or 2.1 percent, from the FY 1993 Budget Request to accommodate Congressional directives in other Subactivities. The Revised Current Plan represents an increase of$4.02 million, or 11.1 percent, over the FY 1992 level.

U.S. POLAR PROGRAMS

The National Science Foundation has relocated polar research programs from the Geosciences Directorate to the Office of the Director to provide the increased top-level attention to these programs that is required by the significant international, national and interagency issues, in environmental, regulatory, scientific and operational arenas. Accordingly funding is requested in FY 1994 in a 1) Polar Programs Appropriation that consolidates Arctic and Antarctic research programs in a U.S. Polar Research Programs Appropriation and 2) U.S. Antarctic Logistics Appropriation to fund Navy logistical support and the final year of the Safety, Environment and Health (SEH) initiative. Both Appropriations are summarized here.

The U.S. Antarctic Program supports national goals in the Antarctic to: maintain the Antarctic Treaty, ensure that the continent continues to be used only for peaceful purposes, foster cooperative research contributing to the solution of regional and world-wide problems, protect the environment, and ensure the equitable and wise use of living and nonliving resources. Scientific research is the means through which these goals are pursued.

The Arctic Research Program supports a significant fraction of arctic research by universities and the coordination of Federal arctic research planning.

The following table summarizes the FY 1994 changes by program showing FY 1992 and FY 1993 on a comparable basis with FY 1994:

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
U.S. Arctic Research Program	$21.13	$25.95	$24.60	$26.20	$1.60	6.5
U.S. Antarctic Research Program . . .	22.00	26.74	26.74	28.48	1.74	6.5
Operations and Science Support	75.37	77.16	72.16	108.42	36.26	50.2
U.S. Antarctic Logistical Support	65.00	59.10	59.10	59.10	0.00	0.0
SEH	30.00	14.00	14.00	6.00	-8.00	-57.1
Subtotal	213.50	202.95	196.60	228.20	31.60	16.1
Aircraft Procurement			49.36		-49.36	-100.0
Total, Activity	$213.50	$202.95	$245.96	$228.20	$-17.76	-7.2

FY 1994 Request

The increase of $31.60 million or 16.1% in the basic programs is offset by a $49.36 million decrease in aircraft procurement for a net decrease of $17.76 million or 7.2% to $228.20 million.

- The Arctic Research Program increase provides for additional environmental research, about $1.60 million, of which $0.47 is global change;
- The U.S. Antarctic Research Program increase provides for additional use of new facilities -- the

new science laboratory and research vessel; and

- The $36.26 million increase in Operations and Science Support includes increased support for science, and environmental activities and facilities requirements similar in nature to those previously supported under the SEH initiative.

Changes in Budget Structure

The U.S. Arctic Research Program, formerly funded in the Research and Related Activities appropriation is now funded in the Polar Research Programs Appropriation as are the U.S. Antarctic Research Program and antarctic Operations and Science Support. U.S. Antarctic Logistical Support and SEH activities are funded from the U.S. Antarctic Logistics Appropriation.

U.S. POLAR RESEARCH PROGRAMS APPROPRIATION: $163,100,000

The U.S. Polar Research Programs Appropriation consolidates funding for both arctic and antarctic research as well as Operations and Science Support for the Antarctic. The polar regions are critical because of their role with respect to world weather and climate, and because of environmental protection considerations. In addition they provide special opportunities for international cooperation and the peaceful use of these regions. There are major differences between the Northern and Southern regions: the Arctic is an ocean basin surrounded mostly by continents; the Antarctic is a continent surrounded by oceans. A key difference that has major program effects is the complete lack of indigenous population in the Antarctic. This lack of population and essential infrastructure means that stations must be established, and all required resources must be imported. The antarctic Operations and Science Support Subactivity funds these efforts.

(Millions of Dollars)

Subactivity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
U.S. Arctic Research Program 1/	[$21.13]	[$25.95]	[$24.60]	$26.20	$1.60	6.5
U.S. Antarctic Research Program	22.00	26.74	26.74	28.48	1.74	6.5
Operations and Science Support	55.37 2/	77.16	72.16	108.42	36.26	50.2
U.S. Antarctic Logistics Support	0.00	59.10	59.10	0.00	-59.10	-100.0
	--------	--------	--------	--------	--------	--------
Total Appropriation	77.37	163.00	158.00	163.10	5.10	3.2
Total, Activity 1/	[$98.50]	[$188.95]	[$182.60]	$163.10	$-19.50	-10.7

1/ Includes amounts funded through the Research and Related Activities appropriation in FY 1992 and FY 1993

2/ An additional $10 million was available for this activity in the U.S. Antarctic Logistics Support Appropriation and an added $10 million was provided from the DOD appropriation, bringing the total support for this activity to $75.37.

FY 1994 REQUEST

The Polar Research Programs Appropriation increases $5.10 million or 3.2 percent from the FY 1993 Current Plan, to a total of $158.00 million. The decrease results primarily from a transfer of Navy antarctic logistics funding of $59.10 million, to the U.S. Antarctic Logistics Appropriation. Transfer of base funding for the Antarctic Research Program along with increases to Operations and Science Support of $36.26 million, increases in the U.S. Antarctic Research Program (USARP) of $1.74 million and for the Arctic Research Program $26.20 million result in a net increase to this Appropriation.

The increase in Operations and Science Support provides for R/V NATHANIEL B. PALMER ice operations, improved field party support, South Pole and communications facilities and equipment primarily to support science, and upgrades of other facilities, particularly Williams Field, in support of operations.

The $1.74 million increase in the USARP allows full use of the new research vessel and science laboratory at McMurdo Station to advance environmental research, and augments astronomy and astrophysics utilizing the unique location of the South Pole.

Total antarctic funding will allow continued global change research on the ozone hole and biological effects of the related increase in ultraviolet radiation reaching the Earth's surface. Ocean studies address the dynamics, paleontology, and ecology of the seas surrounding the continent. Earth studies address geology, geophysics, glaciology, and plate tectonics. These research efforts seek to place antarctic environmental processes in a global context. South Pole astronomy and astrophysics provides new knowledge on the nature and origin of the universe.

The increase in the Arctic Research Program will facilitate global change and other environmental research.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Subactivity	FY 1993 Request	FY 1993 Revised Current Plan	Change	
			Amount	Percent
U.S. Arctic Research Program . . .	[$25.95] 1/	[$24.60]	[$ -1.35]	[-5.2]
U.S. Antarctic Research Program .	26.74	26.74	0.00	0.0
Operations and Science Support	77.16	72.16	-5.00	-6.6
U.S. Antarctic Logistics Support .	59.10	59.10	-0.00	-0.2
	--------	--------	--------	--------
Total, Activity	$188.95	$182.50	$-6.35	-3.4

1/ Funded in the Research and Related Activities Appropriation in FY 1993

The $5.00 million decrease to Operations and Science Support results from congressional actions on the request.

The decrease in the U.S. Arctic Research request of $1.35 million from $25.95 million to $24.60 million results from the reduction to the Research and Related Activities Appropriation from which this Subactivity is funded.

Changes in Budget Structure

The Arctic Research Program has been included in this new Polar Research Activity. Antarctic Operations and Science Support are included too. Navy Logistics except for those which directly support science also have been transferred to the U.S. Antarctic Logistics Appropriation effective in FY 1994.

U.S. ARCTIC RESEARCH PROGRAM: $26,200,000

The National Science Foundation provides about 45 percent of the total Federal Support of university research in the Arctic. About 75 percent of NSF university support of arctic research is provided by the Arctic Research Projects Program Element. The projects reflect scientific interest in the Arctic stretching from the ocean bottom through the ice cover and into space where the interaction of solar radiation with the earth's atmosphere begins. Research also involves arctic land areas and their people, plants and wildlife. In addition to individual projects supported in the various disciplines, the Arctic Systems Science (ARCSS) program focuses on understanding the arctic component of global climate change. Besides supporting arctic research, this Subactivity funds the Arctic Research Commission, an independent Federal agency not a part of NSF but funded through the Foundation for budget convenience.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Percent
Arctic Research Projects	$20.60	$25.39	$24.07	$25.64	$1.57	6.5
Arctic Research Commission	.53	.56	.53	.56	0.03	5.7
	--------	--------	--------	--------	--------	--------
Total, Subactivity	$21.13	$25.95	$24.60	$26.20	$1.60	6.5

FY 1994 BUDGET REQUEST

The FY 1994 budget request for the Arctic Research Program is $26.20 million, an increase of $1.60 million or 6.5 percent above the FY 1993 Current Plan of $24.60 million. Support of Global Change increases by $0.47 million to $12.87 million.

Explanation of Increases:

Arctic Research Projects increases $1.57 million, or 6.5 percent and provides:

- $0.47 million for Arctic Systems Science to expand its land-atmosphere-ice-interaction component. ARCSS develops data for input to modelling the arctic component of global change; and

- $1.1 million for disciplinary research across the arctic disciplines supported, which are primarily environment-related.

The Arctic Research Commission increase of $30,000 or 5.4 percent is toward increased cost of the Commission, whose budget was held level in the previous year.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Revised Current Plan	Change	
			Amount	Percent
Arctic Research Projects	$25.39	$24.07	$ -1.32	-5.2
Arctic Research Commission	.56	.53	-0.03	-5.4
	--------	--------	--------	--------
Total, Subactivity	$25.95	$24.60	$-1.35	-5.2

The FY 1993 Current Plan is $24.60 million, a decrease of $1.35 million, or 5.2 percent, from the FY 1993 Budget Request, and an increase of $3.32 million, or 15.6 percent, over FY 1992 funding of $21.28 million. The decrease is due to unspecified Congressional reductions. It will be applied primarily to disciplinary research which is not a part of special initiatives.

U.S. ANTARCTIC RESEARCH PROGRAM: $28,480,000

The NSF funds and manages the U.S. national program in Antarctica. The science, which is a key element of U.S. antarctic presence, is funded under this and the Operations and Science Support Subactivity. Over 110 research projects in Antarctica are supported each year that can be best or only carried out there. Investigations focus on the earth, the ice, surrounding oceans, the atmosphere and terrestrial and marine biota. The cold, dry atmosphere and continuous view of the southern sky provided by the station at the South Pole provide unique opportunities for astronomical and astrophysical investigations.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Current Plan	FY 1994 Request	Change	
					Amount	Percent
U.S. Antarctic Research Program . .	$22.00	$26.74	$26.74	$28.48	$1.74	6.5
	--------	--------	--------	--------	--------	--------
Total, Subactivity	$22.00	$26.74	$26.74	$28.48	$1.74	6.5

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for U.S. Antarctic Research increases by $1.74 million, or 6.5 percent. This increase will provide for:

- continued and expanded marine research aboard the new icebreaking research vessel, NATHANIEL B. PALMER;
- research activities conducted at the McMurdo science laboratory, which was dedicated in November of 1991 and essentially completed in FY 1993; and
- research in astronomy, aeronomy and space physics that capitalizes on the unique location of the South Pole Station.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Current Plan	Change	
			Amount	Percent
U.S. Antarctic Research Program	$26.74	$26.74	0.00	0.0
	--------	--------	--------	--------
Total, Subactivity	$26.74	$26.74	$0.00	0.0

The FY 1993 Current Plan as directed by the Congress was not reduced.

OPERATIONS AND SCIENCE SUPPORT SUBACTIVITY: $108,420,000

This provides operations and science support by a support contractor, the Navy and other organizations. Antarctic Support Associates (ASA), the major civilian contractor, provides the operations and maintenance of antarctic stations and research ships. The Navy also provides operations and science support which is included here and logistical support under a separate Activity. Stations operated are Palmer, on an island West of the Antarctic Peninsula, McMurdo, the major science and logistics base 2200 miles South of Christchurch, New Zealand, and a station at the South Pole. This subactivity also funds Air support for science provided by both the Navy and by ASA, which also leases two research ships, scientific equipment, communications, transportation of personnel, and services in support of science.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Current Plan	FY 1994 Request	Change	
					Amount	Percent
Operations and Science Support . .	$75.37	$77.16	$72.16	$108.42	$36.26	50.2
	--------	--------	--------	--------	--------	--------
Total, Subactivity	$75.37	$77.16	$72.16	$108.42	$36.26	50.2

The FY 1994 request increases by $36.26 million, or 50.2 percent.

- A breakout of the increase follows:

- Recently identified environmental protection and remediation activities	$8.50
- Year-round **R/V PALMER** in-ice operations, including the helos and remote sensing required for efficient and effective ice operations	4.00
- South Pole facilities including interim science facilities and design for a replacement central station	7.00
- Communications including continued development of intra and intercontinental satellite data transmission and other communications	6.00
- Facility upgrades including the move of Williams Field, McMurdo's airfield on the Ross Iceshelf, and other absolutely necessary facilities updates	6.00
- Improved field party support including the necessary vehicles	3.50
- Partial offset for increased costs of operations	1.26
Total	$36.26

- The increase for science support is $15.50 million to a total $58.60 million. The increase for operations and facilities is $12.26 million, new total $41.32 million. The remaining increase is for environmental protection. The following chart summarizes these changes:

	1993	1994	Change
Science Support	$43.10	$58.60	+ 15.50
Operations & Facilities	29.06	41.32	+ 12.26
Environment	0.00	8.50	+ 8.50
	--------	--------	--------
Total	$72.16	108.42	$36.26

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Current Plan	Change Amount	Change Percent
Operations and Science Support	$77.16	$72.16	-5.00	-6.5
	--------	--------	--------	--------
Total, Subactivity	$77.16	$72.16	$-5.00	-6.5

There was a decrease by the Congress of $5.00 million which was distributed among operations and science support efforts.

Changes in Budget Structure

The only Navy funding remaining here is for operations and in support of science which amounts to $9.90 million of the FY 1994 total; the balance is funded in U.S. Antarctic Logistics.

U.S. ANTARCTIC LOGISTICS APPROPRIATION: $65,100,000

U.S. activities in Antarctica because of their extent and remote location require major logistics. Funds provided under this Appropriation support logistics provided by DOD and the final year of the Safety, Environment and Health (SEH) initiative. This Appropriation contributes to U.S. foreign policy objectives and addresses environmental problems dating to the days when the Navy funded and managed U.S. Antarctic logistics and operations.

(Millions of Dollars)

Subactivity	FY 1992* Actual	FY 1993 Request	FY 1993 Current Plan	FY 1994 Request	Change	
					Amount	Percent
U.S. Antarctic Logistics	$0.00	$0.00	$0.00	$59.10	$59.10	100.0
Operations & Science Support	10.00	0.00	0.00	0.00	0.00	0.0
Safety, Environment and Health ...	0.00	0.00	14.00	6.00	-8.00	-57.1
Aircraft Procurement	0.00	0.00	49.36	0.00	-49.36	-100.0
	--------	--------	--------	--------	--------	--------
Total, Activity	$10.00	$0.00	$63.36	$65.10	$1.74	2.7

* In FY 1992 Navy support and SEH activities were funded directly by DOD in the amount of $105.00 million.

FY 1994 BUDGET REQUEST

The logistics Activity increases by $1.74 million, or 2.7% over the FY 1993 Current Plan to a total of $65.10 million.

CHANGES IN BUDGET STRUCTURE

Navy Logistics are funded here in FY 1994.

The final year of the Safety, Environment and Health initiative remains here.

The procurement of another LC-130 aircraft from this Appropriation is not planned until FY 1997.

U.S. ANTARCTIC LOGISTICS: $59,100,000

This Subactivity funds Navy logistics services for support of the U.S. Antarctic program.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Current Plan	FY 1994 Request	Change	
					Amount	Percent
U.S. Antarctic Logistics	$65.00	$59.10	$59.10	$59.10	$0.00	0.0
	--------	--------	--------	--------	--------	--------
Total, Subactivity	$65.00	$59.10	$59.10	$59.10	$0.00	0.0

FY 1994 BUDGET REQUEST

- Personnel, the largest cost element, includes about 750 military personnel of the Naval Support Force Antarctica (NSFA) and Antarctic Development Squadron Six (VXE-6) at a total of $31.00 million of which $26.30 million is budgeted here. Air logistics includes the cost of VXE-6 flight activity and aircraft maintenance and upgrade. Also included are the costs of additional airlift chartered from the U.S. Air Force and of personnel transportation in connection with the Antarctic Program. These total $20.60 million of which $15.4 million is funded here. The Navy expenses not budgeted here are LC-130 and helicopter direct support of science projects; these are funded as part of the Operations and Science Support Subactivity of the Polar Research Appropriation.

- Surface Transportation costs include the charter of a Military Sealift Command cargo ship for the resupply of McMurdo Station, as well as surface freight charges, and is budgeted at $3.00 million.

- Maintaining and operating the logistics infrastructure on the Antarctic Continent, particularly the base at McMurdo and the adjacent airfields is budgeted at $8.70 million.

- Support of the logistics facilities of the Naval Support Unit in Christchurch and of NSFA and VXE-6 in California amounts to $2.50 million.

- Procurement costs, primarily associated with aircraft upgrades plus other procurements by NSFA, to allow the provision of logistics are budgeted at $3.20 million.

The FY 1994 Budget Request for U.S. Antarctic Logistics is unchanged from the FY 1993 Current Plan.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Current Plan	Change	
			Amount	Percent
U.S. Antarctic Logistics	$59.10	$59.10	0.00	0.0
	--------	--------	--------	--------
Total, Subactivity	$59.10	$59.10	$0.00	0.0

The FY 1993 Current Plan is unchanged from the FY 1993 request.

The request was for support of Navy Logistics which was funded under the U.S. Antarctic Program Activities Appropriation. The funds provided were for the SEH initiative and LC-130 procurement.

SAFETY, ENVIRONMENT AND HEALTH SUBACTIVITY: $6,000,000

This Subactivity funds the final year of the Safety, Environment and Health (SEH) initiative.

The initiative is a comprehensive approach intended to improve safety, environmental and health problems that have accumulated over the years and to meet higher standards in the future. The initiative responds to environmental concerns about human impact on that pristine continent. In addition, safety is a major concern for all operations conducted in this remote and hazardous area.

Accomplishments have included major cleanups at McMurdo and Palmer and of former stations no longer in use, as well as major improvements of safety of buildings used at McMurdo and the South Pole. Funding for FY 1992 and FY 1993 was provided elsewhere.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Current Plan	FY 1994 Request	Change	
					Amount	Percent
Safety, Environment and Health . . .	$0.00	$0.00	$14.00	$6.00	$-8.00	-57.1
	--------	--------	--------	--------	--------	--------
Total, Subactivity	$0.00	$0.00	$14.00	$6.00	$-8.00	-57.1

FY 1994 BUDGET REQUEST

The FY 1994 Budget Request for Safety, Environment and Health is $6.00 million, or 57.1 percent below the FY 1993 Current Plan as a result of planned phase-down of the initiative.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Current Plan	Change	
			Amount	Percent
Safety, Environment and Health	$0.00	$14.00	14.00	N/A
	--------	--------	--------	--------
Total, Subactivity	$0.00	$14.00	$14.00	N/A

Funds were requested by DOD, but were provided directly to NSF.

AIRCRAFT PROCUREMENT

In FY 1993 funds were provided for an LC-130 aircraft to be used by the Navy is support of the U.S. Antarctic Program.

(Millions of Dollars)

Program Element	FY 1992 Actual	FY 1993 Request	FY 1993 Current Plan	FY 1994 Request	Change	
					Amount	Percent
Aircraft Procurement	$0.00	$0.00	$49.36	$0.00	$-49.36	N/A
	--------	--------	--------	--------	--------	--------
Total, Subactivity	$0.00	$0.00	$49.36	$0.00	$-49.36	N/A

FY 1994 BUDGET REQUEST

No additional aircraft is requested in FY 1994 because with the two aircraft provided in FY 1992 the Antarctic Program will have available, three modern LC-130 aircraft.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 CURRENT PLAN

(Millions of Dollars)

Program Element	FY 1993 Request	FY 1993 Current Plan	Change	
			Amount	Percent
Aircraft Procurement	$0.00	$49.36	49.36	N/A
	--------	--------	--------	--------
Total, Subactivity	$0.00	$49.36	$49.36	N/A

Funds were added by the Congress for a ski equipped LC-130 for use in the U.S. Antarctic Program.

ACADEMIC RESEARCH FACILITIES AND INSTRUMENTATION: $55,000,000

The Academic Research Facilities and Instrumentation Activity supports the repair, renovation and in exceptional cases, the replacement of obsolete science and engineering research and research training facilities and the acquisition and/or development of major research instrumentation. This Activity advances our nation's fundamental science and engineering capability by investing in state-of-the-art instruments and facilities.

(Millions of Dollars)

	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change FY 1994 vs. FY 1993
Academic Research Facilities	$16.54	$ 0.00	$37.50	$27.50	$-10.00
Academic Research Instrumentation	16.81	33.00	17.20	27.50	10.30
	--------	--------	--------	--------	--------
Total, Subactivity	$33.35	$33.00	$54.70	$55.00	$0.30

FACILITIES NEEDS FOR REPAIR AND RENOVATION

- At the direction of Congress, NSF has examined the issue of "backlog" in science and engineering research facilities and instrumentation at U.S. universities and colleges. A survey on the 525 largest research performing universities and colleges found that there was a total of 122 million net assigned square feet (NASF) of science and engineering research space. The institutions reported that 13 percent of their existing research space (15.6 million NASF) needed major repair to be used effectively, and an additional 23 percent (28.0 million NASF) needed limited repair. Another 3 percent (3.8 million NASF) was reported to need complete replacement.

AREAS OF GREATEST NEEDS

- Of the 122 million net assigned square feet (NASF) in science and engineering research space, the fields with the largest amounts of space are the biological sciences (27.7 million NASF), the medical sciences (22.3 million NASF), the agricultural sciences (19.9 million NASF), engineering (18.1 million NASF), and the physical sciences (16.4 NASF). Fields with the largest proportions of their research space in need of repair, renovation, or replacement are: agriculture (49 percent), social sciences (40 percent), medical sciences (39 percent) and biological sciences (38 percent).

PERCEIVED NEEDS IN INSTRUMENTATION

- Data from the next instrumentation survey should be available in late summer 1993. In a 1988/89 survey respondents were asked to list the three top priority instruments in their departments and to cite each item's approximate cost and the reason for the need. The total cost of purchasing the priority instruments listed was $1.52 billion. In all fields the main reason cited for need was to upgrade the research capabilities of the departments and centers. The physical sciences, in particular, reported this reason for their priority choices, with 76 percent of the respondents in physics/astronomy and 62 percent of respondents in chemistry. Overall, 58 percent of top-priority items in departments/centers were needed for upgrading capabilities, 17 percent for replacing existing equipment, and 25 percent for expanding the existing capacity.

FY 1994 BUDGET REQUEST

The Academic Research Facilities and Instrumentation Activity increases by $300,000 over the FY 1993 Revised Current Plan, to a total of $55.0 million. The request will be allocated evenly between the Academic Research Facilities Program and the Academic Research Instrumentation Program.

- The Academic Research Facilities Program expects to receive approximatley 400 proposals requesting more than $250 million in Spring 1993. These proposals will compete for FY 1993 and FY 1994 funds. Individual awards will range from $100,000 to $2 million.

- The Academic Research Instrumentation Program will hold a new competition in FY 1994. Instrumentation awards will range from $300,000 to $2 million and will require cost sharing.

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

	FY 1993 Request	FY 1993 Revised Current Plan	Change
Academic Research Facilities	$ 0.00	$37.50	$ 37.50
Academic Research Instrumentation	33.00	17.20	-15.80
	--------	--------	--------
Total, Subactivity	$33.00	$54.70	$21.70

The FY 1993 Revised Current Plan is $54.7 million, an increase of $21.7 million from the FY 1993 Budget Request. Additional funds were directed to Academic Facilities Research as directed by Congress. The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993 which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request".

CRITICAL TECHNOLOGIES INSTITUTE: $1,000,000

The Critical Technologies Institute is a Federally-Funded Research and Development Center that provides analytical support to the Office of Science and Technology Policy; policy guidance for the Institute is provided by an interagency Operating Committee which functions as the governing board of the Institute. The Institute provides assistance to OSTP to identify near-term and long-term objectives for research and development; analyze the production capability and economic viability with respect to such technologies; and provide options for achieving those objectives.

The National Science Foundation's sponsorship will continue to consist of financial, management, and audit oversight. The Institute itself is operated as a separate entity by the present contractor, RAND corporation.

Policy guidance for the Institute is provided by an Operating Committee. The Operating Committee, comprised of the Secretaries, or their designees, of Defense, Health and Human Services, Energy and Commerce, the Administrator of NASA, the Director of the National Science Foundation, and four other members named by the President, will set the Institute policy, priorities, and goals, and will submit an annual report to the President.

(Millions of Dollars)

Activity	FY 1992 Actual 1/	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change
Critical Technologies Institute	$ 0.00	$1.00	$1.00	$1.00	0

1/ Reimbursement from the Department of Defense ($5.0 million) and transfer from the Office of Science and Technology Policy ($1.6 million).

FY 1994 REQUEST

The FY 1994 Budget Request for the Critical Technologies Institute is $1.0 million. The National Science Foundation is requesting funding to continue support of the Critical Technologies Institute. The FY 1994 request is based on the plan developed by the Office of Management and Budget and Congressional direction at the initiation of the Institute. The Department of Defense Authorization Act for FY 1992 placed the management of the Institute under NSF and stated that $6.60 million appropriated to other agencies be transferred or made available to NSF for establishment of the Institute. In addition to these funds, the amount being requested for FY 1994, $1.00 million, will continue funding for the Institute by NSF.

To date the Institute has hosted a critical technology panel and has drafted a report that will be published in the spring of 1993. The Institute has also begun a study of the machine tool industry, as required by the authorizing legislation. The machine tool industry report is scheduled for the autumn of 1993. The Institute has established an office and conference center and begun to host FCCSET support activities, asnd to collect data to aid planning for future FCCSET opportunities.

SALARIES & EXPENSES: $125,800,000

The National Science Foundation is organized into seven program directorates; two administrative units; six staff offices which comprise the Office of the Director; and the National Science Board Office, which provides analytical support to the Board and coordinates its activities with staff throughout the Foundation. The Salaries and Expenses appropriation includes funds for staff salaries, benefits, travel, rent, equipment, information systems, administrative contractual services, supplies, and other operating expenses necessary for support of NSF programs.

(Millions of Dollars)

	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change	
					Amount	Pcnt
Personnel Compensation & Benefits	$78.22	$83.62	$81.30	$83.80	$2.5	3.1
General Operating Expenses	31.77	35.38	34.40	42.00	7.6	22.1
Total	$109.99	$119.00	$115.70	$125.80	$10.1	8.7
FULL-TIME EQUIVALENT EMPLOYMENT	1,203	1,250	1,203	1,203		

FY 1994 BUDGET REQUEST

The FY 1994 request includes funds for 1,203 full-time equivalent staff years who manage and support the programmatic and administrative activity of the Foundation's seven major appropriations and total FY 1994 budget request of $3,180.2 million. Costs associated with the repayment of relocation expenses to GSA and expenses of the Office of Inspector General are requested through separate appropriations and are justified elsewhere in this budget document. The $125.80 million consists of $83.80 million for Personnel Compensation and Benefits (PC&B), and $42.00 for General Operating Expenses.

STAFFING

For more than a decade, both the Foundation's budget and the primary indices of its administrative workload, the number of proposals reviewed and awards managed, have doubled while the staffing level necessary to manage this growing and increasingly complex mix of program workload has remained virtually static. In response to this growth, the Foundation has significantly modified its business practices, including implementation of new electronic technologies to help offset this dramatic increase in programmatic workload. This request responds fully to the Administration's policy directives to reduce federal staffing levels and administrative costs. The currently enacted FY 1993 Salaries & Expenses appropriation would only support 1,167 FTE's. The FY 1993 Supplemental appropriation enables NSF to maintain staffing at the FY 1992 level. The NSF staffing remains constant with the revised FY 1993 level (which assumes the Supplemental).

The chart below shows the planned distribution of staffing by NSF program.

STAFFING
(Full-time Equivalents)

	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Estimate	Difference FY 94/93
Biological Sciences	114	118	114	114	0
Budget, Finance, and Awards Management	118	118	118	118	0
Computer and Information Science and Engineering	62	71	62	62	0
Education and Human Resources	130	140	130	130	0
Engineering	119	121	119	119	0
Geosciences	95	100	95	95	0
Information and Resource Management	168	167	168	168	0
Mathematical and Physical Sciences	121	127	121	121	0
Social, Behavioral and Economic Sciences	136	144	136	136	0
Staff Offices of the Director	141	144	141	141	0
Total	1,203	1,250	1,203	1,203	0

Personnel Compensation and Benefits

(Millions of Dollars)

	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Estimate	Difference FY 94/93
Full Time Equivalent	$63,899,872	$68,503,000	$65,861,000	$67,981,000	$2,120,000
Other Personnel Comp	1,799,934	2,350,000	2,328,000	2,419,000	91,000
NSB and Advisors	193,193	200,000	200,000	200,000	0
Subtotal, Personnel Compensation	65,892,999	71,053,000	8,389,000	70,600,000	2,211,000
Personnel Benefits					
Employer Contributions:					
Health Insurance, Retirement, FICA, etc.	12,175,832	12,417,000	12,761,000	13,000,000	239,000
Other Per. Benefits	151,962	150,000	150,000	200,000	50,000
Subtotal, Per. Benefits	12,327,794	12,567,000	12,911,000	13,200,000	289,000
Total, Personnel Compensation & Benefits	$78,220,793	$83,620,000	$81,300,000	$83,800,000	$2,500,000

Personnel Compensation and Benefits is the single largest component of the Salaries and Expenses appropriation, accounting for approximately two-thirds of the S&E resources. Although the FY 1994 comparability pay increase has been deferred, the Foundation is required to fund within-grade salary increases and career ladder promotions. Personnel Compensation and Benefits costs for FY 1994 total $83.8 million, an increase of $2.5 million over the FY 1993 Revised Current Plan figure of $81.3 million. The primary elements of this increase are:

- annualized cost of the January 1993 COLA (+ $1.7 million)
- other statutory salary advancements (within-grade step increases and career ladder promotions) (+ $0.8 million)

If terminal leave costs exceed projections, the increases will be absorbed from either salary lapses or reductions to travel.

The cost of Advisory and Assistance Services required by the Foundation to provide advice, counsel, critical review and recommendations concerning specific scientific and administrative activities are included within the total cost of personnel compensation. These FY 1994 costs will be approximately $200,000.

TRAVEL
FY 1993/1994

	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Estimate	Difference FY 94/93
Biological Sciences	$269,246	$414,000	$341,000	$402,000	$61,000
Budget, Finance, and Awards Management	80,120	75,000	75,000	83,000	8,000
Computer and Information Science and Engineering	187,557	286,000	248,000	284,000	36,000
Education and Human Resources	263,167	403,000	352,000	424,000	72,000
Engineering	450,306	636,000	521,000	583,000	62,000
Geosciences	422,856	470,000	432,000	508,000	76,000
Information and Resource Management	70,503	75,000	75,000	83,000	8,000
Mathematical and Physical Sciences	431,963	645,000	565,000	630,000	65,000
Social, Behavioral and Economic Sciences	239,776	374,000	311,000	385,000	74,000
Staff Offices of the Director	526,789	622,000	580,000	618,000	38,000
Total	$2,942,283	$4,000,000	$3,500,000	$4,000,000	$500,000

--**Travel** costs increase by $500,000 attributable to the increasing complexity of NSF program management resulting from expansion in crosscutting and inter-disciplinary programs. This increased program complexity requires extraordinary coordination with external communities, including post-award oversight and evaluation at research centers; close coordination of industry/university cooperative centers; oversight and coordination with academic, state and industrial partners.

Moreover, as the number of crosscutting programs increase, new research communities and centers develop, such as biotechnology and manufacturing, which are geographically diffuse and with which NSF does not have the established ties and linkages as it does with the more traditional research institutions. It is critical that the Foundation attain greater visibility with these new communities and emerging partnerships, through increased attendance at conferences, symposia, and meetings, to ensure effective and efficient program management and coordination. NSF will be able to support these increases in travel and still respond to the Administration's policies to reduce costs by implementing other administrative efficiencies in equipment and consulting services.

GENERAL OPERATING EXPENSES (Including Travel)

	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Cur Plan	FY 1994 Estimate	Difference FY 94/93
Travel	$2,942,283	$4,000,000	$3,500,000	$4,000,000	$500,000
Transportation of Things	347,630	467,000	358,000	400,000	42,000
Rents and Communications:					
Office Space Rentals	9,153,522	9,261,000	9,900,000	16,100,000	6,200,000
Data Processing Equipment and Other Rentals	488,895	429,000	360,000	400,000	40,000
Telephone, Telegraph, Post	2,823,112	3,506,000	2,990,000	3,100,000	110,000
Subtotal, Rents & Communications	12,465,529	13,196,000	13,250,000	19,600,000	6,350,000
Printing and Reproduction	924,588	1,202,000	925,000	934,000	9,000
Consulting Services	326,801	310,000	310,000	300,000	(10,000)
Other Contractual Services:					
Administrative Contracts	3,073,363	2,632,000	3,359,000	3,259,000	(100,000)
DP Operations & Maint.	3,473,863	4,000,000	3,793,000	4,391,000	598,000
DP Software Development	3,084,070	3,600,000	2,410,000	3,200,000	790,000
Employment Training	606,389	584,000	465,000	610,000	145,000
Subtotal, Other Contr. Services	10,237,685	10,816,000	10,027,000	11,460,000	1,433,000
Supplies and Material:					
Office & Printing	765,000	1,022,000	775,000	950,000	175,000
Data Processing	125,000	203,000	125,000	150,000	25,000
Subtotal, Supplies & Materials	890,000	1,225,000	900,000	1,100,000	200,000
Equipment:					
Admin. Services Equipment	659,742	550,000	859,100	544,400	(314,700)
Data Processing Equipment	2,972,012	3,608,000	4,264,900	3,655,600	(609,300)
Subtotal, Equipment	3,631,754	4,158,000	5,124,000	4,200,000	(924,000)
Director's Representation	5,996	6,000	6,000	6,000	0
TOTAL, Other Expenses	$31,772,266	$35,380,000	$34,400,000	$42,000,000	$7,600,000

OTHER GENERAL OPERATING EXPENSES

-- **Transportation of Things** will increase by $42,000. These expenses consist of contracts for labor support to move furniture and equipment, as well as for household goods of incoming and outgoing temporary professional staff.

-- **Office Space Rentals** will increase by $6,200,000. This represents the increase in rental costs from the present location to the new building. The new location consolidates four crowded downtown locations in a single state-of-the-art facility with approximately one-third more workspace and conference facilities. There may also be some dual rent costs incurred during FY 1994 not included in the above estimate which would result from dual occupancy of the new building and the existing location at 1800 G Street. These costs will be absorbed from reductions in travel costs.

-- **Telephone, Telegraph, Cable and Postage Costs** increases $110,000. The increase reflects cost increases in mailing, and normal telephone and postage rate increases.

-- **Administrative Contracts** decrease by $100,000. Warehousing, supply services, mail handling, addressing services and equipment repair and maintenance increase by $240,000. Health services will increase by $70,000 due to loss of shared support from another agency. These increases are offset by reductions of one-time costs for FY 1993 relocation expenses of about $410,000, which are primarily for telecommunications, consulting, and building improvements.

-- **Employee Training** increases by $145,000 and restores training to the FY 1992 level.

-- **Supplies and Materials** will increase by $200,000. This increase includes print plant paper, copier paper, printing supplies, office and miscellaneous supplies, and anticipates demand for additional and replacement of supply items related to the move to the new facility.

-- **Administrative Services Equipment** will decrease $315,000 due to the completion of one-time purchases in FY 1993 of equipment and furniture for the new building, including the library, the archives, conference rooms, and other facilities.

INFORMATION SYSTEMS

Information systems costs constitute, with personnel costs and operating expenses, the third component of the FY 1994 Salaries and Expenses appropriation. Since the mid-1980's, the NSF information processing environment has been transformed from one characterized primarily by typewriters and hand-held calculators to one with distributed multi-functional workstations or personal computers that support a wide range of automated work processes, including electronic mail, sign-in and sign-out and timekeeping systems, and powerful computational capabilities.

The distributed systems model is supported by a powerful central system that provides access to large databases which are essential to integrating the vast amounts of data concerning proposals, reviewers, awards, and financial systems that form the critical core of the Foundations' managerial and administrative operations.

NSF continues to make a major investment in new technology to improve business operations and respond to significant workload increases. Changes in work practices resulting from this investment are apparent in many aspects of NSF activities; the program officers' decision making processes are heavily supported at all stages by state-of-the-art distributed computational resources and centralized databases; and program staff regularly communicate with the research community electronically.

The FY 1994 budget for Information Systems will enable the Foundation to continue, in its new location, long-range plans to keep current with these and other technological innovations to ensure that the Foundation's information infrastructure adequately supports its expanding programmatic activity.

The following narrative details the specific components of the Information Systems budget request for FY 1994:

-- **Data Processing Operations and Maintenance** will increase by $598,000. Of this increase, $348,000 is requested for additional contractor costs associated with maintaining NSF's expanded technological base and the annual incremental increases in maintenance and operational contracts. The remaining $250,000 increase is required for the Customer Service Center in order to respond to requirements for additional training, assistance, and documentation relating to the growth of new technologies and systems at NSF (see next category). As a new technology or system is implemented, there is a corresponding need to train and assist Foundation staff in effectively applying the technology or the system to the work they perform.

-- **Data Processing Software Development** increases by $790,000. With the ever increasing number of proposals and increased Agency responsibilities, NSF will not be able to effectively handle its future workload with the technologies currently in place. In order to achieve the President's goal of using technology "to make Government work better, harder, and smarter," the Foundation must continue to improve its information systems in times of limited personnel resources. The amount requested will allow NSF to begin a program of utilizing new "down-sized" technologies now being introduced by the computer industry. Systems will be developed that will operate locally on personal computers rather than on the current centralized and somewhat inflexible mainframe environment. The new systems will be dynamic and will be designed to be responsive to the continuing changes in business practices throughout the agency. The systems will also be designed to take advantage of new hardware, software, and data communications technologies as they are introduced in the future. NSF will eventually be able to eliminate its reliance on mainframe processors and move to smaller, less expensive database servers.

-- **Data Processing Equipment** decreases by $609,000. The decrease is due to the one-time costs in FY 1993 associated with the purchase of equipment needed to fully utilize and integrate our Data Processing capabilities at the new Headquarters location. The amount requested will allow NSF to purchase the infrastructure (i.e., imaging hardware and software, and distributed database servers, software, and gateways) necessary to take advantage of the new systems being developed. Investments to maximize productivity will also be made through the purchase of items such as an upgraded internet connection to improve outside electronic communications; a collaboration lab to facilitate panel reviews; and a video prototype with the eventual goal of providing visual access to meetings and training courses at individual workstations thereby substantially reducing costs for training and travel while at the same time increasing personnel availability.

PERSONNEL SUMMARY

	FY 1992 Actual	FY 1993 Revised Current Plan	FY 1994 Request
Total Compensable Workyears	1,208	1,208	1,208
Full-time Equivalent Employment	1,203	1,203	1,203
FTE Overtime and Holiday Hours	5	5	5
Average GS Grade	9.77	9.85	9.85
Average Salary	$52,650	$54,389	$55,589

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

	FY 1993 Request	FY 1993 Revised Current Plan	Change
Personnel Compensation and Benefits	$83.62	$81.30	$-2.32
General Operating Expenses			
Travel	4.00	3.50	-.50
Information Systems	11.43	10.59	-.84
Other General Expenses	19.95	20.31	+.36
	--------	--------	-------
Subtotal, General Operating Expenses	35.38	34.40	-.98
	--------	--------	--------
Total, Salaries and Expenses	$119.00	$115.70	$-3.30
FTE	1,250	1,203	47

The FY 1993 Revised Current Plan includes the President's stimulus package for FY 1993, which is described in the section of the Foundation's FY 1994 Budget Request labeled "FY 1993 Supplemental Request." The stimulus package for the Salaries and Expenses appropriation totaled $4.70 million; of this amount, $1.70 was allocated for Personnel Compensation and Benefits and $3.00 million for General Operating Expenses. The difference between the FY 1993 Request and the FY 1993 Revised Current Plan, while an overall decrease, reflects the addition of the $4.70 million stimulus package.

Personnel Compensation and Benefits (PC&B) -- The difference between the FY 1993 budget request of $83.62 million and the FY 1993 Revised Current Plan of $81.30 million for PC&B is a net decrease of $2.32 million and reflects a reduction of staffing levels from 1,250 to 1,203. The Revised Current Plan amount, nevertheless, reflects the addition of $1.70 million from the stimulus package which increase funded FTE levels from 1,167 to the current level of 1,203.

General Operating Expenses -- The difference between the FY 1993 Request of $35.38 million and the FY 1993 Revised Current Plan of $34.40 million is a net decrease of $980,000. This Revised Current Plan amount, nevertheless, reflects the addition of $3.00 million from the stimulus package which will primarily fund relocation-related expenses in FY 1993. The net reduction of $980,000 is attributable to reductions in data processing software development and travel. Within this net reduction, however, are increases in the following: Office Space Rental; Administrative Contracts; and Data Processing Equipment. The increase of of $639,000 in Office Space Rental is attributable to the additional rental costs of acquiring the Vermont Avenue space; these costs were excluded from the original 1993 estimates. The increase of $727,000 in Administrative Contracts is due to one-time costs for consulting, building improvements, and dual operations associated with the Headquarters relocation. Data Processing Equipment costs, which increase by $627,000, are for the one-time purchase of equipment needed to fully utilize and integrate NSF data processing capabilities in the new location.

DETAIL OF PERMANENT POSITIONS

	FY 1992 Actual	FY 1993 Revised Current Plan	FY 1994 Request
Executive Level II	1	1	1
Executive Level III	1	1	1
Subtotal	2	2	2
ES-6	14	17	17
ES-5	17	19	19
ES-4	54	61	61
ES-3	7	6	6
ES-2	2	5	5
ES-1	13	9	9
Subtotal	107	117	117
AD	246	237	237
GS/GM-15	73	76	76
GS/GM-14	81	83	83
GS/GM-13	65	67	67
GS-12	86	87	87
GS-11	49	50	50
GS-10	11	8	8
GS-9	57	58	58
GS-8	69	71	71
GS-7	104	100	100
GS-6	89	87	87
GS-5	46	45	45
GS-4	27	26	26
GS-3	4	3	3
Subtotal	761	761	761
UNGRADED	3	3	3
TOTAL PERMANENT POSITIONS	1,119	1,119	1,119
FTE	1,203	1,203	1,203

NATIONAL SCIENCE FOUNDATION HEADQUARTERS RELOCATION: $5,200,000

The NSF Headquarters Relocation appropriation account provides reimbursement to the General Services Agency (GSA) for expenses incurred by GSA pursuant to the relocation of the National Science Foundation.

(Millions of Dollars)

Activity	FY 1992 Actual	FY 1993 Request	FY 93 Revised Current Plan	FY 1994 Request	Change
NSF Headquarters Relocation	$ 00.00	$ 00.00	$ 00.00	$ 5.20	n/a
	--------	--------	--------	--------	--------
Total, Activity	$0.00	$0.00	$0.00	$ 5.20	n/a

FY 1994 REQUEST

The National Science Foundation will complete a consolidation of all office facilities into single headquarters building in FY 1994. The move is currently scheduled to take place over a six month period from July through December 1993. In January 1993,the National Science Foundation, the General Services Administration (GSA), and OMB entered into an interagency agreement regarding the NSF Headquarters relocation. As part of this agreement, GSA agreed to provide up to $9.1 million to NSF in FY 1993 for relocation expenses; agreed to fund all rent costs in the new NSF building during FY 1993 ($5.90 M); and first-year payments on a five year lease-to-purchase acquisitions for systems furniture and a telephone system. Under the terms of the agreement with GSA, repayment of these items is deferred for FY 1993. NSF agreed to request funds to make annual reimbursements to GSA in five installments beginning in FY 1994.

The FY 1994 request of $5.20 million for reimbursement to GSA includes $3.40 million to pay the first of five equal installments to GSA for relocation expenses provided in FY 1992 ($2.20 million), the cost of the actual relocation in FY 1993 ($9.10 million), and the FY 1993 rent on the new building ($5.90 million). The total amount to be reimbursed for relocation expenses/rent is $17.20 million, to be reimburses over a five-year period at $3.40 million per year. Additionally, the FY 1994 request includes $1.80 million to pay the second of five annual installments for 1,500 systems furniture workstations and a telephone system for the new building. The table below summarizes these reimbursements ($ in millions).

	1994	1995	1996	1997	1998	TOTAL
Funds Adv. FY 1993	$1.8	$1.8	$1.8	$1.8	$1.8	$9.1
FY 92 Expenses	0.4	0.4	0.4	0.4	0.4	2.2
FY 93 Rent (VA.)	1.2	1.2	1.2	1.2	1.2	5.9
Systems Furniture	1.5	1.5	1.5	1.5	0.0	6.0
Telephones	0.3	0.3	0.3	0.3	0.1	1.2
TOTAL	$5.2	$5.2	$5.2	$5.2	$3.4	$24.4

OFFICE OF INSPECTOR GENERAL: $4,100,000

The FY 1994 request for the Office of Inspector General (OIG) Activity is $4.1 million, an overall increase of $412,000 or approximately 11.1% over the FY 1993 Current Plan of $3.688 million.

(Millions of Dollars)

Activity	FY 1992 Actual	FY 1993 Request	FY 1993 Revised Current Plan	FY 1994 Request	Change Amount	Change Pcnt
Personnel Compensation & Benefits	$2.06	$2.42	$2.42	$2.69	$0.27	11.2
Other Operating Expenses	1.80	1.58	1.27	1.41	0.14	11.0
	--------	--------	--------	--------	--------	--------
Total, Activity	$3.86	$4.00	$3.69	$4.10	$0.41	11.1
Full-Time Equivalent Employment .	33	38	38	42		

DESCRIPTION

In February 1989, the National Science Board established the Office of Inspector General for NSF pursuant to the Inspector General Act Amendments of 1988. The statute confers on the Office of Inspector General the responsibility and the authority to:

- Conduct and supervise audits of NSF programs and operations, including organizations that receive NSF funding.
- Conduct investigations concerning NSF programs and operations, including organizations that receive NSF funding.
- Evaluate allegations of misconduct in science, such as data fraud or plagiarism involving scientists that receive NSF funding
- Provide leadership and coordination and recommend policies for activities designed to:

  (a) promote economy, efficiency, and effectiveness in the administration of NSF programs and operations, and

  (b) prevent and detect fraud and abuse in NSF programs and operations.

- Issue Semiannual Reports to keep the National Science Board and Congress fully and currently informed about problems and deficiencies relating to the administration of NSF programs and operations and the necessity for and progress of corrective action.

The OIG is comprised of three operational organizations: Audit, Investigations, and Oversight. The Office of Audit is responsible for external audits of NSF grants and contracts at universities and commercial and nonprofit organizations that receive NSF funding. Internal audits are also conducted within NSF to evaluate financial and administrative aspects of NSF activities; to evaluate data processing systems employed by NSF; and to assess the adequacy of internal controls. The Office of Audit ensures that management implements recommendations included in all reports issued by OIG and the General Accounting Office. The Office of Audit is also responsible for pre-award audits and for recommending to NSF's Division of Grants and Contracts final indirect cost rates applicable to NSF awards.

The Investigations Unit is responsible for investigating charges of criminal and administrative violations by NSF staff and funded organizations.

The Office of Oversight is responsible for evaluating allegations of misconduct in science and engineering, such as data fraud and plagiarism. The Oversight Office also manages OIG's inspection program; reviews and evaluates the processing of proposals for funding from NSF; monitors procedures used to ensure external peer oversight of NSF programs; and monitors adherence to NSF conflict-of-interest regulations as they apply to new and former employees.

FY 1994 BUDGET REQUEST

An increase of $412,000 over the FY 1993 Current Plan is requested for the Office of Inspector General in FY 1994.

Activity	FY 1992 Actual	FY 1993 Revised Current Plan	FY 1994 Request	Difference FY 93/94
Personnel Compensation & Benefits	$2,068,894	$2,420,000	$2,685,000	$265,000
Travel and Transportation of Persons	65,228	100,000	110,000	10,000
Rental Payments to GSA	0	0	0	0
Communications, Utilities and Miscellaneous Charges	0	0	0	0
Printing and Reproduction	0	0	0	0
Other Services	1,615,078	1,078,000	1,220,000	142,000
Supplies and Materials	22,393	35,000	35,000	0
Equipment	85,872	55,000	50,000	-5,000
Total, Activity	3,857,465	$3,688,000	$4,100,000	$412,000

During its first 3 years of operation, the Office of Inspector General addressed the requirements of the Inspector General Act with the addition of experienced personnel in the legal, scientific, and criminal investigation disciplines. Additional personnel were needed to address concerns in the areas of scientific misconduct, conflict-of-interest and other ethical areas, and allegations of criminal activity. There were also adjustments within the office necessary to meet the additional demands of the Inspector General Act amendments. These include production of semiannual reports to Congress, establishment of working relationships with the National Science Board (the new statutory supervisor of the Office of Inspector General), attainment of professional standards imposed on the disciplines represented in the office, and redefinition of day-to-day working relationships with NSF.

In response to recommendations from the Senate Committee on Governmental Affairs, OIG proposes to increase, over a period of several years, the number of audits that are conducted at organizations that receive NSF funding. Additional audit resources are also needed to compensate for the expected increase in the budget of the Foundation in the FY 1993 supplemental budget request, and in the proposed FY 1994 budget. OIG also has substantial increased audit responsibilities under the Chief Financial Officers Act of 1990.

OIG also requests additional resources in order to effectively manage the growing number of allegations involving misconduct in science. Current resources are inadequate and far below the resources allocated for misconduct cases by the Public Health Service (PHS). OIG now employs three scientists to manage a caseload for which PHS devotes over eight scientists.

Since the Department of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1990, (Public Law 101-144), provides for a separate appropriation for NSF's Office of Inspector General, the FY 1994 Request separately identifies the resources needed to support the Office of Inspector General. These resources include amounts for personnel compensation and benefits; contract audits; operational travel; and office supplies, materials, and equipment.

Personnel compensation and benefits costs will increase by $265,000 or 11.2% over the FY 1993 Plan. The increase requested for salaries and benefits reflects the costs to support 42 FTEs, an increase of 4 FTEs over the FY 1993 level. Two FTEs will be used to employ additional scientists to resolve allegations of misconduct in science. The other 2 FTEs will be used to employ additional auditors. Along with the hiring of 2 additional auditors, contracts with C.P.A. firms for external audits will increase by $150,000 to $1.2 million, to compensate for the expected increase in research supported by NSF and to improve the audit cycle. Travel will increase by $10,000 to support the operational travel needs of the staff performing an increased number of external audits, investigations, and inspections. Other operating expenses for OIG will decrease by $13,000.

The table showing the detail of permanent positions is a summary of Permanent Positions as of the end of FY 1992 and estimated to be filled at the end of FY 1993 and FY 1994. OMB Circular No. A-11 (Section 13.2) defines "permanent positions" as those which are occupied or to be occupied by full-time employees with permanent appointments.

DETAIL OF PERMANENT POSITIONS

Grade	FY 1992 Actual	FY 1993 Revised Current Plan	FY 1994 Request
ES	2	4	4
Subtotal	2	4	4
AD	3	5	7
Subtotal	3	5	7
GS/GM-15	1	0	1
GS/GM-14	6	7	5
GS/GM-13	7	6	7
GS-12	1	1	4
GS-11	2	3	3
GS-10	--	--	--
GS-9	4	6	6
GS-8	1	2	2
GS-7	4	3	2
GS-6	--	--	1
GS-5	3	1	--
GS-4	--	---	--
Subtotal	29	29	31
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Total Permanent Positions	34	38	42

CHANGES BETWEEN FY 1993 REQUEST AND FY 1993 REVISED CURRENT PLAN

(Millions of Dollars)

Activity	FY 1993 Request	FY 1993 Revised Current Plan	Change
Personnel Compensation & Benefits	$2.42	$2.42	$0.00
Other Operating Expenses	1.58	1.27	-0.31
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Total	$4.00	$3.69	$-0.31

The reduction from the requested budget amount has negatively impacted our contract audit services line item.

NATIONAL SCIENCE FOUNDATION

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Conduct of Research			
Basic Research	$1,741,470,928	$1,921,435,850	$2,047,490,999
Applied Research	126,926,299	151,180,726	169,475,745
Development	0	0	0
Subtotal, Conduct of R&D	1,868,397,227	2,072,616,576	2,216,966,744
(Conduct of R&D Performed by Colleges and Universities.)	(1,497,929,749)	(1,632,316,746)	(1,748,669,388)
R&D Facilities			
Land, Building and Fixed Equipment	50,161,050	75,480,165	97,518,177
Major Equipment	51,409,220	62,423,259	87,839,079
Subtotal, R&D Facilities & Major Equipment	101,570,270	137,903,424	185,357,256
Total, Support of R&D	1,969,967,497	2,210,520,000	2,402,324,000
Non-Investment Activities*	189,119,613	332,274,000	322,100,000
Education and Training	388,042,000	397,376,000	455,776,000
TOTAL	$2,547,129,110	$2,940,170,000	$3,180,200,000

Quantitative Data Table

Proposal Summary			
Number of Proposals Received	57,334	63,243	69,771
Dollars Requested (Total)	$14,232,837,892	$15,624,100,993	$17,133,947,640
Action Summary			
Number of Awards	20,128	21,107	22,296
Dollars Obligated (Total)	2,547,129,110	2,940,170,000	3,180,200,000
Dollar Distribution by Performer			
Universities	1,845,769,187	2,048,919,541	2,236,134,235
Industry	64,851,127	74,152,624	81,168,519
Federal Agencies	12,799,559	17,938,305	16,961,150
Other	623,709,237	799,159,530	845,936,095
Subtotal, Dollar Distribution by Performer	2,547,129,110	2,940,170,000	3,180,200,000
Personnel			
Senior Scientists			
Number of Scientists Supported	23,501	25,275	26,951
Amount of Scientist Support	279,344,302	303,272,512	326,625,775
Number of Years of Scientist Support	4,951	5,276	5,682
Postdoctoral Support			
Number of Postdoctorals Supported	4,183	4,369	4,594
Amount of Postdoctoral Support	80,180,158	86,224,095	91,958,133
Graduate Students			
Number of Graduate Students Supported	19,068	20,629	22,129
Amount of Graduate Student Support	245,692,138	274,246,641	297,332,748
Other Personnel Costs			
Amount of Support	258,991,415	282,181,687	301,750,490
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	50,161,050	75,480,165	97,518,177
Major Equipment	51,409,220	62,423,259	87,839,079
Other Equipment and Instrumentation	200,334,840	217,492,054	234,000,862
Subtotal, R&D Fac., Equip. and Instrumentation	301,905,110	355,395,478	419,358,118
Other Direct Research Costs**	733,073,429	801,459,023	875,934,136
Indirect Costs	458,822,945	505,116,564	545,140,600
Non-Investment Activities	189,119,613	332,274,000	322,100,000
TOTAL	$2,547,129,110	$2,940,170,000	$3,180,200,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultents, Computer Services, Subcontracts, Travel, and Fringe Benefits.

RESEARCH AND RELATED ACTIVITIES

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$1,689,636,276	$1,838,325,850	$1,933,972,999
Applied Research	108,486,951	122,826,726	133,389,745
Development	0	0	0
Subtotal, Conduct of R&D	1,798,123,227	1,961,152,576	2,067,362,744
(Conduct of R&D Performed by Colleges and Universities.)	(1,475,929,749)	(1,605,576,746)	(1,695,694,388)
R&D Facilities			
Land, Building and Fixed Equipment	31,094,453	36,884,165	64,018,177
Major Equipment	34,600,107	45,223,259	60,339,079
Subtotal, R&D Facilities & Major Equipment	65,694,560	82,107,424	124,357,256
Total, Support of R&D	1,863,817,787	2,043,260,000	2,191,720,000
Non-Investment Activities*	7,317,897	12,970,000	13,080,000
Education and Training	0	0	0
TOTAL	$1,871,135,684	$2,056,230,000	$2,204,800,000

Quantitative Data Table

Proposal Summary			
Number of Proposals Received	36,704	40,375	43,432
Dollars Requested (Total)	$10,391,043,883	$11,303,202,837	$12,127,072,820
Action Summary			
Number of Awards	17,366	18,036	18,583
Dollars Obligated (Total)	1,871,135,684	2,056,230,000	2,204,800,000
Dollar Distribution by Performer			
Universities	1,528,284,091	1,672,974,911	1,790,276,522
Industry	41,815,828	50,816,008	55,025,899
Federal Agencies	10,904,850	15,850,383	15,422,895
Other	290,130,915	316,588,697	344,074,684
Subtotal, Dollar Distribution by Performer	1,871,135,684	2,056,230,000	2,204,800,000
Personnel			
Senior Scientists			
Number of Scientists Supported	18,841	20,040	20,763
Amount of Scientist Support	222,561,712	244,381,092	257,455,168
Number of Years of Scientist Support	3,634	3,897	4,072
Postdoctorel Support			
Number of Postdoctorels Supported	3,918	4,074	4,243
Amount of Postdoctorel Support	76,390,607	81,552,742	86,284,116
Graduate Students			
Number of Graduate Students Supported	15,083	16,209	17,188
Amount of Graduate Student Support	188,310,169	209,228,847	225,867,520
Other Personnel Costs			
Amount of Support	220,083,883	240,258,574	251,222,130
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	31,094,453	36,884,165	64,018,177
Major Equipment	34,600,107	45,223,259	60,339,079
Other Equipment and Instrumentation	171,287,458	185,287,253	196,278,973
Subtotal, R&D Fac., Equip. and Instrumentation	236,982,018	267,394,677	320,636,229
Other Direct Research Costs**	521,546,019	563,152,749	586,470,012
Indirect Costs	397,943,379	437,291,319	463,784,826
Non-Investment Activities	7,317,897	12,970,000	13,080,000
TOTAL	$1,871,135,684	$2,056,230,000	$2,204,800,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

BIOLOGICAL SCIENCES

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	262,760,000	277,963,000	297,460,000
Applied Research	11,590,000	13,500,000	14,450,000
Development	0	0	0
Subtotal, Conduct of R&D	274,350,000	291,463,000	311,910,000
(Conduct of R&D Performed by Colleges and Universities.)	(237,773,146)	(252,614,000)	(270,300,000)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	274,350,000	291,463,000	311,910,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$274,350,000	$291,463,000	$311,910,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	6,555	6,964	7,454
Dollars Requested (Total)	2,399,077,053	2,548,502,000	2,723,990,000
Action Summary			
Number of Awards	3,275	3,176	3,180
Dollars Obligated (Total)	274,350,000	291,463,000	311,910,000
Dollar Distribution by Performer			
Universities	237,773,146	252,614,000	270,300,000
Industry	2,495,015	2,651,000	2,830,000
Federal Agencies	228,270	242,000	260,000
Other	33,853,569	35,956,000	38,520,000
Subtotal, Dollar Distribution by Performer	274,350,000	291,463,000	311,910,000
Personnel			
Senior Scientists			
Number of Scientists Supported	2,105	2,143	2,212
Amount of Scientist Support	27,302,791	28,889,812	30,711,009
Number of Years of Scientist Support	636	647	668
Postdoctoral Support			
Number of Postdoctorals Supported	995	1,012	1,046
Amount of Postdoctoral Support	21,715,436	22,986,562	24,464,015
Graduate Students			
Number of Graduate Students Supported	1,843	1,876	1,927
Amount of Graduate Student Support	20,624,083	21,812,960	23,187,922
Other Personnel Costs			
Amount of Support	31,705,883	33,517,006	35,602,491
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment			
Major Equipment	0	0	0
Other Equipment and Instrumentation	24,471,304	26,003,678	29,753,678
Subtotal, R&D Fac., Equip. and Instrumentation	24,471,304	26,003,678	29,753,678
Other Direct Research Costs**	74,803,401	80,310,741	85,352,069
Indirect Costs	73,727,102	77,942,241	82,838,816
Non-Investment Activities	0	0	0
TOTAL	$274,350,000	$291,463,000	$311,910,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$177,114,902	$222,544,000	$250,867,000
Applied Research	6,430,992	8,586,000	9,874,000
Development	0	0	0
Subtotal, Conduct of R&D	183,545,894	231,130,000	260,741,000
(Conduct of R&D Performed by Colleges and Universities.)	(155,131,544)	(193,468,000)	(217,884,000)
R&D Facilities			
Land, Building and Fixed Equipment	1,338,000	1,585,000	1,759,000
Major Equipment	25,491,079	30,198,000	33,510,000
Subtotal, R&D Facilities & Major Equipment	26,829,079	31,783,000	35,269,000
Total, Support of R&D	210,374,973	262,913,000	296,010,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	210,374,973	262,913,000	296,010,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	3,328	4,240	4,796
Dollars Requested (Total)	1,269,491,393	1,596,072,000	1,797,742,000
Action Summary			
Number of Awards	1,542	1,874	2,086
Dollars Obligated (Total)	210,374,973	262,913,000	296,010,000
Dollar Distribution by Performer			
Universities	184,632,644	228,420,000	256,665,000
Industry	4,797,182	6,346,000	7,209,000
Federal Agencies	488,341	664,000	758,000
Other	20,456,806	27,483,000	31,378,000
Subtotal, Dollar Distribution by Performer	210,374,973	262,913,000	296,010,000
Personnel			
Senior Scientists			
Number of Scientists Supported	1,397	1,777	2,010
Amount of Scientist Support	19,582,356	24,888,000	28,167,000
Number of Years of Scientist Support	288	367	415
Postdoctoral Support			
Number of Postdoctorals Supported	94	117	131
Amount of Postdoctoral Support	2,570,638	3,135,000	3,508,000
Graduate Students			
Number of Graduate Students Supported	1,464	1,867	2,117
Amount of Graduate Student Support	22,477,261	28,678,000	32,519,000
Other Personnel Costs			
Amount of Support	17,901,407	21,902,000	24,513,000
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	1,338,000	1,585,000	1,759,000
Major Equipment	25,491,079	30,198,000	33,510,000
Other Equipment and Instrumentation	23,511,088	29,170,000	32,811,000
Subtotal, R&D Fac., Equip. and Instrumentation	50,340,167	60,953,000	68,080,000
Other Direct Research Costs**	59,873,901	76,311,000	86,224,000
Indirect Costs	37,629,243	47,046,000	52,999,000
Non-Investment Activities	0	0	0
TOTAL	210,374,973	262,913,000	296,010,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

ENGINEERING

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$192,751,950	$221,672,000	241,385,000
Applied Research	$65,351,901	$75,158,000	$81,665,000
Development	0	0	0
Subtotal, Conduct of R&D	$258,103,851	$296,830,000	$323,050,000
(Conduct of R&D Performed by Colleges and Universities.)	($227,120,216)	($255,400,000)	(278,210,000)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	$258,103,851	$296,830,000	$323,050,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$258,103,851	$296,830,000	$323,050,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	8,490	9,910	10,900
Dollars Requested (Total)	$2,041,287,455	$2,300,000,000	$2,520,000,000
Action Summary			
Number of Awards	2,929	3,215	3,505
Dollars Obligated (Total)	$258,103,851	$296,830,000	$323,050,000
Dollar Distribution by Performer			
Universities	$227,120,216	$255,400,000	$278,210,000
Industry	$25,077,881	$33,095,000	$35,840,000
Federal Agencies	$480,000	$565,000	$625,000
Other	$5,425,754	$7,770,000	$8,375,000
Subtotal, Dollar Distribution by Performer	258,103,851	296,830,000	323,050,000
Personnel			
Senior Scientists			
Number of Scientists Supported	3,600	4,220	4,590
Amount of Scientist Support	$37,544,389	$44,100,000	$48,050,000
Number of Years of Scientist Support	548	650	707
Postdoctoral Support			
Number of Postdoctorals Supported	315	349	380
Amount of Postdoctoral Support	$4,836,699	$5,430,000	$5,940,000
Graduate Students			
Number of Graduate Students Supported	2,964	3,400	3,740
Amount of Graduate Student Support	$48,421,168	$55,240,000	$60,470,000
Other Personnel Costs			
Amount of Support	$26,973,427	$31,150,000	$33,790,000
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	$19,098,004	$22,100,000	$24,170,000
Subtotal, R&D Fac., Equip. and Instrumentation	19,098,004	22,100,000	24,170,000
Other Direct Research Costs**	$58,966,803	$67,020,000	$72,390,000
Indirect Costs	$62,263,361	$71,790,000	$78,240,000
Non-Investment Activities	0	0	0
TOTAL	$258,103,851	$296,830,000	$323,050,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$16,378,694	$0	$0
Applied Research	1,646,056	0	0
Development	0	0	0
Subtotal, Conduct of R&D	18,024,750	0	0
(Conduct of R&D Performed by Colleges and Universities.)	(18,024,750)	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	18,024,750	0	0
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$18,024,750	$0	$0

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	36	0	0
Dollars Requested (Total)	$81,860,523	$0	$0
Action Summary			
Number of Awards	29	0	0
Dollars Obligated (Total)	18,024,750	0	0
Dollar Distribution by Performer			
Universities	18,024,750	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	0	0	0
Subtotal, Dollar Distribution by Performer	18,024,750	0	0
Personnel			
Senior Scientists			
Number of Scientists Supported	201	0	0
Amount of Scientist Support	1,135,766	0	0
Number of Years of Scientist Support	22	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	49	0	0
Amount of Postdoctoral Support	633,218	0	0
Graduate Students			
Number of Graduate Students Supported	210	0	0
Amount of Graduate Student Support	1,301,813	0	0
Other Personnel Costs			
Amount of Support	763,639	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	1,087,044	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	1,087,044	0	0
Other Direct Research Costs**	12,390,824	0	0
Indirect Costs	712,446	0	0
Non-Investment Activities	0	0	0
TOTAL	$18,024,750	$0	$0

*Includes "Collection of Information."
**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

Note: For FY 1993 and 1994, the EPSCoR program was transferred to the Office of Systemic Reform in EHR.

GEOSCIENCES

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research..	$369,974,518	$407,451,000	$424,857,000
Applied Research......................................	3,502,455	3,858,000	4,003,000
Development...	0	0	0
Subtotal, Conduct of R&D..............................	373,476,973	411,309,000	428,860,000
(Conduct of R&D Performed by Colleges and Universities.)..	(257,114,742)	(283,479,000)	(296,472,000)
R&D Facilities			
Land, Building and Fixed Equipment....................	2,450,542	2,743,000	2,888,000
Major Equipment.......................................	4,905,761	6,992,000	16,782,000
Subtotal, R&D Facilities & Major Equipment	7,356,303	9,735,000	19,670,000
Total, Support of R&D.................................	380,833,276	421,044,000	448,530,000
Non-Investment Activities*................................	0	0	0
Education and Training....................................	0	0	0
TOTAL...	$380,833,276	$421,044,000	$448,530,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received..........................	4,807	5,308	5,676
Dollars Requested (Total).............................	$1,286,502,521	$1,421,722,000	$1,518,165,000
Action Summary			
Number of Awards......................................	2,664	2,938	3,063
Dollars Obligated (Total).............................	380,833,276	421,044,000	448,530,000
Dollar Distribution by Performer			
Universities..	257,114,742	283,479,000	296,472,000
Industry..	3,015,083	3,350,000	3,557,000
Federal Agencies......................................	3,598,376	3,975,000	4,250,000
Other...	117,105,075	130,240,000	144,251,000
Subtotal, Dollar Distribution by Performer............	380,833,276	421,044,000	448,530,000
Personnel			
Senior Scientists			
Number of Scientists Supported........................	4,422	4,913	5,131
Amount of Scientist Support...........................	44,712,841	49,609,000	51,705,000
Number of Years of Scientist Support..................	759	823	875
Postdoctoral Support			
Number of Postdoctorals Supported.....................	602	672	702
Amount of Postdoctoral Support........................	6,678,870	7,379,000	7,694,000
Graduate Students			
Number of Graduate Students Supported.................	1,827	2,021	2,105
Amount of Graduate Student Support....................	21,609,891	23,898,000	24,891,000
Other Personnel Costs			
Amount of Support.....................................	81,174,799	90,037,000	93,505,000
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment...................	2,450,542	2,743,000	2,888,000
Major Equipment.......................................	4,905,761	6,992,000	16,782,000
Other Equipment and Instrumentation...................	21,406,377	23,400,000	24,208,000
Subtotal, R&D Fac., Equip. and Instrumentation........	28,762,680	33,135,000	43,878,000
Other Direct Research Costs**.............................	131,593,514	143,837,000	150,889,000
Indirect Costs..	66,300,681	73,149,000	75,968,000
Non-Investment Activities.................................	0	0	0
TOTAL...	$380,833,276	$421,044,000	$448,530,000

*Includes "Collection of Information."
**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

ARCTIC RESEARCH PROGRAM
RESEARCH AND RELATED ACTIVITIES
Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$21,115,475	$24,571,000	$0
Applied Research	12,677	29,000	0
Development	0	0	0
Subtotal, Conduct of R&D	21,128,152	24,600,000	0
(Conduct of R&D Performed by Colleges and Universities.)	(18,470,916)	(23,000,000)	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	21,128,152	24,600,000	0
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$21,128,152	$24,600,000	$0

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	251	295	0
Dollars Requested (Total)	$92,912,445	$108,773,000	$0
Action Summary			
Number of Awards	206	245	0
Dollars Obligated (Total)	21,128,152	24,600,000	0
Dollar Distribution by Performer			
Universities	18,470,916	23,000,000	0
Industry	1,305,339	69,797	0
Federal Agencies	915,776	1,036,203	0
Other	436,121	494,000	0
Subtotal, Dollar Distribution by Performer	21,128,152	24,600,000	0
Personnel			
Senior Scientists			
Number of Scientists Supported	204	231	0
Amount of Scientist Support	1,994,400	2,259,000	0
Number of Years of Scientist Support	44	50	0
Postdoctoral Support			
Number of Postdoctorals Supported	18	21	0
Amount of Postdoctoral Support	271,068	306,000	0
Graduate Students			
Number of Graduate Students Supported	92	105	0
Amount of Graduate Student Support	893,012	1,013,000	0
Other Personnel Costs			
Amount of Support	2,788,383	3,161,000	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	930,000	1,052,000	0
Subtotal, R&D Fac., Equip. and Instrumentation	930,000	1,052,000	0
Other Direct Research Costs**	10,531,075	12,591,000	0
Indirect Costs	3,720,214	4,218,000	0
Non-Investment Activities	0	0	0
TOTAL	$21,128,152	$24,600,000	$0

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

MATHEMATICAL AND PNYSICAL SCIENCES

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$580,056,025	$608,257,139	$636,629,598
Applied Research	$10,768,116	$11,583,437	$12,342,146
Development	$0	$0	$0
Subtotal, Conduct of R&D	590,824,141	619,840,576	648,971,744
(Conduct of R&D Performed by Colleges and Universities.)	(496,989,454)	(525,788,173)	(554,465,621)
R&D Facilities			
Land, Building and Fixed Equipment	27,305,911	32,556,165	59,371,177
Major Equipment	4,203,267	8,033,259	10,047,079
Subtotal, R&D Facilities & Major Equipment	31,509,178	40,589,424	69,418,256
Total, Support of R&D	622,333,319	660,430,000	718,390,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$622,333,319	$660,430,000	$718,390,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	8,686	8,808	9,156
Dollars Requested (Total)	$2,598,038,505	$2,656,663,233	$2,857,617,786
Action Summary			
Number of Awards	5,021	4,683	4,682
Dollars Obligated (Total)	622,333,319	660,430,000	718,390,000
Dollar Distribution by Performer			
Universities	519,842,696	558,234,338	610,266,755
Industry	548,990	541,359	599,031
Federal Agencies	1,359,000	1,572,750	1,705,220
Other	100,582,633	100,081,552	105,818,994
Subtotal, Dollar Distribution by Performer	622,333,319	660,430,000	718,390,000
Personnel			
Senior Scientists			
Number of Scientists Supported	5,812	5,618	5,615
Amount of Scientist Support	75,578,998	78,599,321	81,632,404
Number of Years of Scientist Support	1,109	1,123	1,153
Postdoctoral Support			
Number of Postdoctorals Supported	1,743	1,782	1,855
Amount of Postdoctoral Support	38,103,293	40,376,553	42,579,130
Graduate Students			
Number of Graduate Students Supported	5,783	5,980	6,300
Amount of Graduate Student Support	65,401,223	70,049,833	75,631,196
Other Personnel Costs			
Amount of Support	57,126,440	58,601,320	61,698,334
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	27,305,911	32,556,165	59,371,177
Major Equipment	4,203,267	8,033,259	10,047,079
Other Equipment and Instrumentation	77,587,114	80,116,602	81,608,563
Subtotal, R&D Fac., Equip. and Instrumentation	109,096,292	120,706,026	151,026,819
Other Direct Research Costs**	142,190,525	149,495,198	154,292,021
Indirect Costs	134,836,548	142,601,749	151,530,097
Non-Investment Activities	0	0	0
TOTAL	$622,333,319	$660,430,000	$718,390,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

SOCIAL, BEHAVIORAL, AND ECONOMIC SCIENCES

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$69,484,712	$75,867,711	$82,774,401
Applied Research	9,184,754	10,112,289	11,055,599
Development	0	0	0
Subtotal, Conduct of R&D	78,669,466	85,980,000	93,830,000
(Conduct of R&D Performed by Colleges and Universities.)	(65,304,981)	(71,827,573)	(78,362,767)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	78,669,466	85,980,000	93,830,000
Non-Investment Activities*	7,317,897	12,970,000	13,080,000
Education and Training	0	0	0
TOTAL	$85,987,363	$98,950,000	$106,910,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	4,551	4,850	5,450
Dollars Requested (Total)	$621,873,988	$671,470,604	$709,558,034
Action Summary			
Number of Awards	1,700	1,905	2,067
Dollars Obligated (Total)	85,987,363	98,950,000	106,910,000
Dollar Distribution by Performer			
Universities	65,304,981	71,827,573	78,362,767
Industry	4,576,338	4,762,852	4,990,868
Federal Agencies	3,835,087	7,795,430	7,824,675
Other	12,270,957	14,564,145	15,731,690
Subtotal, Dollar Distribution by Performer	85,987,363	98,950,000	106,910,000
Personnel			
Senior Scientists			
Number of Scientists Supported	1,100	1,138	1,205
Amount of Scientist Support	14,710,171	16,035,959	17,189,755
Number of Years of Scientist Support	228	237	254
Postdoctoral Support			
Number of Postdoctorals Supported	102	121	129
Amount of Postdoctoral Support	1,581,385	1,939,627	2,098,971
Graduate Students			
Number of Graduate Students Supported	900	960	999
Amount of Graduate Student Support	7,581,718	8,537,054	9,168,402
Other Personnel Costs			
Amount of Support	1,649,905	1,890,248	2,113,305
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	3,196,527	3,444,973	3,727,732
Subtotal, R&D Fac., Equip. and Instrumentation	3,196,527	3,444,973	3,727,732
Other Direct Research Costs**	31,195,976	33,587,810	37,322,922
Indirect Costs	18,753,784	20,544,329	22,208,913
Non-Investment Activities	7,317,897	12,970,000	13,080,000
TOTAL	$85,987,363	$98,950,000	$106,910,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

EDUCATION AND HUMAN RESOURCES

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$29,980,000	$56,670,000	$59,170,000
Applied Research	$18,294,000	$28,054,000	$35,754,000
Development			
Subtotal, Conduct of R&D	48,274,000	84,724,000	94,924,000
(Conduct of R&D Performed by Colleges and Universities.)	(42,479,360)	(72,797,120)	(79,397,120)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	$48,274,000	$84,724,000	$94,924,000
Non-Investment Activities*	$5,100,000	$5,400,000	$5,400,000
Education and Training	$388,042,000	$397,376,000	$455,776,000
TOTAL	$441,416,000	$487,500,000	$556,100,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	19,891	21,968	25,059
Dollars Requested (Total)	$3,417,331,441	3,774,102,156	4,305,186,070
Action Summary			
Number of Awards	2,420	2,673	3,049
Dollars Obligated (Total)	441,416,000	487,500,000	556,100,000
Dollar Distribution by Performer			
Universities	262,129,135	294,508,630	337,882,713
Industry	23,035,299	23,336,616	26,068,286
Federal Agencies	1,894,709	2,087,922	434,699
Other	154,356,857	167,566,833	191,714,301
Subtotal, Dollar Distribution by Performer	441,416,000	487,500,000	556,100,000
Personnel			
Senior Scientists			
Number of Scientists Supported	4,276	4,777	5,454
Amount of Scientist Support	52,733,355	54,164,420	61,730,607
Number of Years of Scientist Support	1,229	1,275	1,445
Postdoctoral Support			
Number of Postdoctorals Supported	173	191	218
Amount of Postdoctoral Support	2,409,551	3,111,353	3,683,017
Graduate Students			
Number of Graduate Students Supported	3,837	4,236	4,633
Amount of Graduate Student Support	55,924,949	63,217,794	68,469,228
Other Personnel Costs			
Amount of Support	34,979,775	37,337,923	42,279,380
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	27,745,364	30,641,991	34,953,869
Subtotal, R&D Fac., Equip. and Instrumentation	27,745,364	30,641,991	34,953,869
Other Direct Research Costs**	207,162,427	232,486,274	269,840,125
Indirect Costs	55,360,579	61,140,245	69,743,774
Non-Investment Activities	5,100,000	5,400,000	5,400,000
TOTAL	$441,416,000	$487,500,000	$556,100,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

U.S. POLAR RESEARCH PROGRAMS

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$21,854,652	$26,440,000	$28,180,000
Applied Research	145,348	300,000	300,000
Development	0	0	0
Subtotal, Conduct of R&D	22,000,000	26,740,000	28,480,000
(Conduct of R&D Performed by Colleges and Universities.)	(22,000,000)	(26,740,000)	(28,480,000)
R&D Facilities			
Land, Building and Fixed Equipment	2,519,749	1,100,000	6,000,000
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	2,519,749	1,100,000	6,000,000
Total, Support of R&D	24,519,749	27,840,000	34,480,000
Non-Investment Activities*	62,851,251	193,520,000	167,520,000
Education and Training	0	0	0
TOTAL	$87,371,000	$221,360,000	$202,000,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	366	500	540
Dollars Requested (Total)	$185,000,000	$290,000,000	$313,000,000
Action Summary			
Number of Awards	251	295	300
Dollars Obligated (Total)	87,371,000	221,360,000	202,000,000
Dollar Distribution by Performer			
Universities	22,000,000	26,740,000	28,480,000
Industry	0	0	0
Federal Agencies	0	0	0
Other	65,371,000	194,620,000	173,520,000
Subtotal, Dollar Distribution by Performer	87,371,000	221,360,000	202,000,000
Personnel			
Senior Scientists			
Number of Scientists Supported	384	458	488
Amount of Scientist Support	4,049,235	4,727,000	5,034,000
Number of Years of Scientist Support	88	105	112
Postdoctoral Support			
Number of Postdoctorals Supported	92	104	111
Amount of Postdoctoral Support	1,380,000	1,560,000	1,665,000
Graduate Students			
Number of Graduate Students Supported	148	184	196
Amount of Graduate Student Support	1,457,020	1,800,000	1,917,000
Other Personnel Costs			
Amount of Support	3,927,757	4,585,190	4,882,980
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	2,519,749	1,100,000	6,000,000
Major Equipment	0	0	0
Other Equipment and Instrumentation	1,302,018	1,562,810	1,648,020
Subtotal, R&D Fac., Equip. and Instrumentation	3,821,767	2,662,810	7,648,020
Other Direct Research Costs**	4,364,983	5,820,000	6,213,000
Indirect Costs	5,518,987	6,685,000	7,120,000
Non-Investment Activities	62,851,251	193,520,000	167,520,000
TOTAL	$87,371,000	$221,360,000	$202,000,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

ARCTIC RESEARCH PROGRAM

Research and Development Special Analysis

	Actual FY 1992***	Estimate FY 1993***	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$0	$0	$26,168,000
Applied Research	0	0	32,000
Development	0	0	0
Subtotal, Conduct of R&D	0	0	26,200,000
(Conduct of R&D Performed by Colleges and Universities.)	0	0	(24,495,000)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	26,200,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$0	$0	$26,200,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	0	0	315
Dollars Requested (Total)	$0	$0	$115,843,000
Action Summary			
Number of Awards	0	0	261
Dollars Obligated (Total)	0	0	26,200,000
Dollar Distribution by Performer			
Universities	0	0	24,495,000
Industry	0	0	74,334
Federal Agencies	0	0	1,103,556
Other	0	0	527,110
Subtotal, Dollar Distribution by Performer	0	0	26,200,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	246
Amount of Scientist Support	0	0	2,406,000
Number of Years of Scientist Support	0	0	53
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	22
Amount of Postdoctoral Support	0	0	326,000
Graduate Students			
Number of Graduate Students Supported	0	0	112
Amount of Graduate Student Support	0	0	1,079,000
Other Personnel Costs			
Amount of Support	0	0	3,366,000
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	1,120,000
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	1,120,000
Other Direct Research Costs**	0	0	13,411,000
Indirect Costs	0	0	4,492,000
Non-Investment Activities	0	0	0
TOTAL	$0	$0	$26,200,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

***Dollars amounts for FY 1992 and FY 1993 reported under Research and Related Activities.

ACADEMIC RESEARCH FACILITIES AND INFRASTRUCTURE

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	16,546,848	37,496,000	27,500,000
Major Equipment	16,809,113	17,200,000	27,500,000
Subtotal, R&D Facilities & Major Equipment	33,355,961	54,696,000	55,000,000
Total, Support of R&D	33,355,961	54,696,000	55,000,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$33,355,961	$54,696,000	$55,000,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	373	400	425
Dollars Requested (Total)	$239,462,568	$256,796,000	$272,845,750
Action Summary			
Number of Awards	91	103	103
Dollars Obligated (Total)	33,355,961	54,696,000	55,000,000
Dollar Distribution by Performer			
Universities	33,355,961	54,696,000	55,000,000
Industry	0	0	0
Federal Agencies	0	0	0
Other	0	0	0
Subtotal, Dollar Distribution by Performer	33,355,961	54,696,000	55,000,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	16,546,848	37,496,000	27,500,000
Major Equipment	16,809,113	17,200,000	27,500,000
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	33,355,961	54,696,000	55,000,000
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	0	0	0
TOTAL	$33,355,961	$54,696,000	$55,000,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

CRITICAL TECHNOLOGIES INSTITUTE

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	0	1,000,000	1,000,000
Education and Training	0	0	0
TOTAL	$0	$1,000,000	$1,000,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	0	0	0
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	0	0	0
Dollars Obligated (Total)	0	1,000,000	1,000,000
Dollar Distribution by Performer			
Universities	0	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	0	1,000,000	1,000,000
Subtotal, Dollar Distribution by Performer	0	1,000,000	1,000,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	0	1,000,000	1,000,000
TOTAL	$0	$1,000,000	$1,000,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

SALARIES AND EXPENSES

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	109,993,000	115,696,000	125,800,000
Education and Training	0	0	0
TOTAL	$109,993,000	$115,696,000	$125,800,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	0	0	0
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	0	0	0
Dollars Obligated (Total)	109,993,000	115,696,000	125,800,000
Dollar Distribution by Performer			
Universities	0	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	109,993,000	115,696,000	125,800,000
Subtotal, Dollar Distribution by Performer	109,993,000	115,696,000	125,800,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	109,993,000	115,696,000	125,800,000
TOTAL	$109,993,000	$115,696,000	$125,800,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

NATIONAL SCIENCE FOUNDATION HEADQUARTERS RELOCTION

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research..	$0	$0	$0
Applied Research......................................	0	0	0
Development...	0	0	0
Subtotal, Conduct of R&D..............................	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)..	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment....................	0	0	0
Major Equipment.......................................	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D.................................	0	0	0
Non-Investment Activities*..................................	0	0	5,200,000
Education and Training.....................................	0	0	0
TOTAL...	$0	$0	$5,200,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received............................	0	0	0
Dollars Requested (Total)...............................	$0	$0	$0
Action Summary			
Number of Awards..	0	0	0
Dollars Obligated (Total)...............................	0	0	5,200,000
Dollar Distribution by Performer			
Universities..	0	0	0
Industry..	0	0	0
Federal Agencies..	0	0	0
Other...	0	0	5,200,000
Subtotal, Dollar Distribution by Performer............	0	0	5,200,000
Personnel			
Senior Scientists			
Number of Scientists Supported........................	0	0	0
Amount of Scientist Support...........................	0	0	0
Number of Years of Scientist Support..................	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported.....................	0	0	0
Amount of Postdoctoral Support........................	0	0	0
Graduate Students			
Number of Graduate Students Supported.................	0	0	0
Amount of Graduate Student Support....................	0	0	0
Other Personnel Costs			
Amount of Support.....................................	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment.....................	0	0	0
Major Equipment...	0	0	0
Other Equipment and Instrumentation.....................	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation.........	0	0	0
Other Direct Research Costs**...............................	0	0	0
Indirect Costs..	0	0	0
Non-Investment Activities...................................	0	0	5,200,000
TOTAL...	$0	$0	$5,200,000

*Includes "Collection of Information."
**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

OFFICE OF INSPECTOR GENERAL

Research and Development Special Analysis

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Support of R&D			
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	3,857,465	3,688,000	4,100,000
Education and Training	0	0	0
TOTAL	$3,857,465	$3,688,000	$4,100,000

Quantitative Data Table

	Actual FY 1992	Estimate FY 1993	Estimate FY 1994
Proposal Summary			
Number of Proposals Received	0	0	0
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	0	0	0
Dollars Obligated (Total)	3,857,465	3,688,000	4,100,000
Dollar Distribution by Performer			
Universities	0	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	3,857,465	3,688,000	4,100,000
Subtotal, Dollar Distribution by Performer	3,857,465	3,688,000	4,100,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	3,857,465	3,688,000	4,100,000
TOTAL	$3,857,465	$3,688,000	$4,100,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

MONDAY, MARCH 29, 1993.

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

WITNESSES

JOHN H. GIBBONS, PH.D., DIRECTOR

LIONEL S. JOHNS, ASSOCIATE DIRECTOR—DESIGNATE, TECHNOLOGY

KARL ERB, PH.D., ASSOCIATE DIRECTOR—ACTING, PHYSICAL SCIENCES AND ENGINEERING

RICHARD DALBELLO, SPECIAL ASSISTANT—SPACE

BARBARA FERGUSON, ADMINISTRATIVE OFFICER

HEARING CALLED TO ORDER

Mr. STOKES. The committee will come to order.

The OSTP is requesting $5,170,000, 40 FTEs, and six detailees for fiscal year 1994.

Dr. Gibbons, at this time it is a pleasure to welcome you before our subcommittee. This of course is your first time to appear here before the subcommittee.

It is my first time to be Chairman of the committee. Mr. Lewis' first time to be the Ranking Minority Member and first time for Mr. Thornton to be on the committee at all. So we have got a lot of firsts here today.

It is a pleasure to have you here and at this time we would like to recognize you to introduce anyone who is with you. After that, if you would just give us your opening statement, we will put the entire statement into the record and then if you would like to summarize, we would be happy to have you do so.

Mr. GIBBONS. Thank you, Mr. Chairman.

I take a great deal of pleasure to appear before you in this new capacity. And I take it, since I am new and you are new, we will be very charitable with each other.

Mr. STOKES. That is right.

Mr. GIBBONS. It is——

Mr. LEWIS. Wait just a minute.

Mr. STOKES. Dick said that word may not be the proper word.

Mr. GIBBONS. I brought along a number of my people today because I thought they should get to know you and the Members of the committee better and to listen to the proceedings today. I will undoubtedly run into some trouble from time to time.

If I might call on them for an immediate answer to help me out, I would appreciate that opportunity, Mr. Chairman.

Mr. STOKES. We would be pleased to have you do so.

Mr. GIBBONS. I do want to submit my written testimony for the record, and I would like to go quickly through it with you, if I might, as a way to begin the afternoon.

Mr. STOKES. Sure.

Mr. GIBBONS. The testimony has a description of our budget request. It also describes some of the work of the Federal Coordinating Council for Science, Engineering, and Technology that I know the committee is familiar with and then I also review some of the so-called technology initiatives that were contained in the President's economic package that was released in San Jose a month ago.

I would like to give a few highlights from those things, if I might, sir.

Mr. STOKES. Sure.

SUMMARY STATEMENT OF JOHN H. GIBBONS

Mr. GIBBONS. I think you know what the office is. It was created by Congress to coordinate science and technology policy for the White House and in doing so to try to help assure that the full technology and science resources of the Executive Branch are brought together in the most propitious and efficient way.

There are many issues, as you know, that spill across the boundaries of the particular jurisdictions of the various agencies, and so increasingly it is up to the White House to assure good coordination and integration of the work across the agencies. That is one of the principal responsibilities we have in OSTP.

We have requested $5.17 million intended to support 40 staffers and a maximum of six detailees. And this, as I believe the committee understands, is a considerable change from recent years. We are trying to cut down on the total number of detailees at the agency and increase our full-time staffing as a way, in part, to increase the in-house institutional memory and professional capability at the office and be a little bit more exacting about the size of the effort.

We have, as you know, been constrained in terms of the size of this operation. Our assignment of 40 personnel plus six detailees came as a part of the White House effort to cut down on the total numbers of people in the White House, to streamline the White House operation. And a part of that was to integrate into the OSTP the functions and activities of the National Space Council and the National Critical Materials Council, so the proposal before you includes not just the original OSTP but those other two activities as well.

RESPONSIBILITIES OF OSTP

I try to point out at the first of my testimony some of the specific responsibilities that the office has. One, obviously, is to make recommendations to the President about current major issues on science and technology.

For instance, this includes assistance to the President in identifying key subcabinet level technical people for the different agencies. I am also charged with directing and coordinating the so-called FCCSET, the Federal Coordinating Council for Science, Engineering, and Technology and its many committees and subgroups, and this requires a lot of time and attention of our people.

FCCSET draws together the collective resources of the agencies; for example, on such things as helping mount a national information infrastructure with the private sector, or on combining public and private resources in technology and education and training in school and work activities, or on addressing global environmental issues. These efforts take a lot of our time.

We are charged also with anticipating new developments or implications of the developments in science and new implications of technology. Some of these have to do with very hard science. Some of them have to do with the implications of the applications of science, for instance, ethical issues associated with advanced biotechnology and medical procedures. So we not only kick the tires, as it were, of hard technology, but we look at the social impacts of that technology and how it affects public policy.

We have a lot of work in international science. There are an extraordinary number of agreements that OSTP has to shepherd and coordinate. I just came from a meeting, for instance, a planning session for the U.S.-Japan Bilateral Science and Technology Agreement. We feel this activity is important because it enables the Executive Branch to work cooperatively across the different executive agencies.

As Director of OSTP and Assistant to the President, I have also been asked to become a member of the so-called National Economic Council. This is another way to integrate my office's work in technology policy with the National Economic Council's responsibilities in fiscal, economic, and regulatory policy. These combinations will really make effective Federal policy. This integration bears on how we think about proceeding with major initiatives under the President's long-term investment plan.

And we have been, as I mentioned, directed to absorb the essential functions of the National Space Council and the National Critical Materials Council. We are just in the process of doing that now.

One of the areas that I have been swept up in more than I had anticipated was the question of the way NASA is reorganizing itself to be a more streamlined agency. OSTP has helped address questions about the space station and how it can be restructured in its design so that it doesn't consume the other responsibilities and concerns of NASA such as aeronautics and space science.

REQUESTED INCREASE IN OSTP'S BUDGET

If we ignore the $2 million that basically are pass-through funds for the Consortia for International Earth Science Information Network, then the bottom line is that we are requesting an increase of funding of $945,000.

Now, this is largely accounted for with the increased personnel costs that we have as we get our full-time people on board and the rather substantial overhead costs that come with these people under the so-called FERS compensation. This basically doubles our overhead for people compared to CSRS, and you will see that reflected in the basis for the increase in funds.

We also have requested a small number of dollars to enable us to use a limited degree of contracting so that we can access very specialized information and capabilities that in the earlier days might have been available through detailees or other methods. This is a small amount of funds but when we consider the size of the office and the scope of the work we have to do, we simply need a little flexibility in reaching out and finding specialized help.

We also hope to increase substantially the amount of work we do in interfacing not just across the executive agencies but with the private sector people, both industry, university and otherwise. This requires again travel funds and the like to be able to make that possible.

FCCSET INITIATIVES

In my testimony, I mentioned a number of FCCSET initiatives. These are mechanisms that we try to use to reach across and pull together the work within the various executive agencies so that the whole of this activity can be greater than the sum of the parts.

We cut down on duplication of effort. We try to make the dollars add up in the most maximal way. I mentioned a half a dozen things in that section. I would only like to refer to a couple of them, if I might.

HIGH PERFORMANCE COMPUTING

One activity undertaken by my predecessor, which I have great admiration for, is the effort to make more effective use of the Federal coordinating committees. A great source of encouragement about how effective this can be is the work that has been going on in high-performance computing and communications. Here we have been able to draw together a substantial number of agencies and help make their work truly additive rather than duplicative in any way. I feel that the progress being made in that particular area of FCCSET is a good example for things we would like to do in other areas.

They have been able to broaden the reach of the computing and communications infrastructure. We hope to be able now to include access by medical facilities, libraries, educational institutions, and private sector, industrial users throughout the U.S. This is a part of our effort not only to have the Federal Government itself to reach out and use these kinds of resources in delivering public services, but at the same time help create, as it were, a market pool of users that will help encourage the private sector as they actually put the system into place.

We want to use Federal resources to help demonstrate the potential of specialized software in improving such things as health care, manufacturing, energy use and education. While there has been a lot of talk about education and training, we feel that it is time to try to use the muscle of advanced technology in making this happen more realistically not only in our K to 12, but in our school-to-work transition and in our lifelong learning activities. A national information infrastructure can be very helpful in that regard.

GLOBAL CHANGE RESEARCH

I won't refer to global change research except that it is continuing and we feel it is another example of a very effective way to utilize national resources. I might only add parenthetically that we believe both the archival information as well as the current capabilities of the defense and intelligence communities relevant to the study of the earth's environment represent valuable resources. These resources have been constrained to the intelligence and defense sectors, but, with careful orchestration, we feel they can be made very helpful and useful to these nondefense needs. They may enable us in the outyears to reduce the resource requirements of a given amount of global climate studies.

ADVANCED MANUFACTURING TECHNOLOGY

Our work in advanced manufacturing technology will be increased under the President's plan. Working with the Federal agencies involved, including Defense and Commerce and Energy, Interior, EPA, NASA, NSF and Agriculture, we hope to advance the state-of-the-art of manufacturing technology and make it more readily available to the smaller business community, which has less access to this sort of advanced technology compared to the larger companies in the U.S.

We are emulating, a little bit, some of the successes we have seen in Europe, especially in Germany and in Japan in terms of methods and outreach.

THE TECHNOLOGY INITIATIVE

And I will end up, Mr. Chairman, by describing the technology initiative of the President. We assisted, along with the National Economic Council and others in the Executive Branch, in preparing some ideas for the President back in February on the opportunities that technology and science can provide our Nation in terms of long-term investment for a more resilient and stronger economy and for making government itself more efficient, more practical, and more user friendly, one might say.

We developed a three-pronged attack. The first is to try to provide long-term economic growth that not only creates jobs, but also protects environmental quality. A second strategy is to make our government itself work more efficiently and more responsively. And third, as an underpinning to all of this, is a world leadership in basic science, mathematics and engineering.

We hope that three-prong attack will most directly bring to bear the fruits of science and technology on the enterprise of our national investment strategy for the future.

THE R&E TAX CREDIT

At the end of my testimony, I give six short examples of the sorts of initiatives that come out of this three-pronged attack. The first is one that was derived in combination with the National Economic Council. A part of our intent is to provide a better seed ground for innovation to occur and take root right here in the U.S., to grow into good jobs for our people. We believe a permanent research and experimentation tax credit can help prepare the seed bed. In times past, it has always been on a temporary basis. Firms have not been able to depend on it as a long-term strategy because they didn't know whether it would be around six months from now.

The proposal is to make that a permanent tax credit which will help draw more entrepreneurs into creating new businesses which, as you know, Mr. Chairman, is the way you create new jobs.

INFORMATION INFRASTRUCTURE

The second initiative is to invest in an information infrastructure. In a partnership with the private sector we will institute the kinds of policies that will enable the private sector to make these investments and put that infrastructure in place. The public sector will be able to use the infrastructure for such things as education and government services.

The third initiative is the one I mentioned to you a little while ago, promoting advanced manufacturing technology and its availability to individuals and small businesses in particular.

A CLEAN CAR

A fourth initiative is an example of our emphasis on the intersection of public-private interests and the resultant, very powerful partnerships. We have proposed cooperative work on a new automobile, a major industry in the U.S. which represents 20 percent of our entire economy in this sector.

We know that we have been under increasing pressure from foreign competition. And we also know that such things as air pollution and the like are major public disbenefits of the automobile. And we have gone pretty far along the road in trying to cut down on pollution, especially in the urban areas, that comes out of automobiles.

So the question is how could we line up the public interests in having automobiles that emit less pollutants, are safer, and are less dependent on imported oil and more able to run off of domestic energy supplies with the interests of the automobile sector in remaining competitive in a very competitive global economy? We believe we have an opportunity here for a long-term relationship between the government and the automobile industry in which the public interests are clearly identified and defensible, and the private interests are, too, and they are lined up in the same direction.

I will be happy to talk about that further with you, if you would like.

EDUCATION AND TRAINING

Next is our issue of technology for education and training. We have found that there are a lot of very advanced technologies and experiences available, for example, in the Department of Defense, that have never reached out and gotten into the classroom, in K to 12, or even in other parts of our economy, such as worker training.

Our intent here is to try to help recognize the new opportunities that advanced technologies give us in performing and improving our educational system, not just for those who would be scientists or engineers, but for our general populace so they would be able to compete and have better jobs in a global marketplace. We also need to understand where this technology is taking us in terms of the requirements for these people.

It is a new venture that bridges all the way from the Department of Defense to the Department of Education and we feel that there are a lot of opportunities here if we go to work.

ENERGY EFFICIENCY IN FEDERAL BUILDINGS

The final initiative has to do with the government's own need to improve itself. If you look at Federal buildings around the nation, you find that there is a lot of inefficient use of energy, and a lot of opportunities to increase that efficiency of use and save a lot of money all at the same time.

This is an example of an investment that has every bit of rational economic payoff attached to it, and at the same time, gives us less environmental impact from energy conversion. This is the way to go.

So there is a substantial package, including energy efficiency but also Federal procurements and the like, that we put together, that we believe will show by example that the Federal Government has a long way to improve itself and can in a very cost-effective way.

Mr. Chairman, those are my brief comments, and I hope they give you an idea of the scope of the sorts of things our little office is involved in.

I would be delighted to hear your comments and questions about this. And we appreciate your support of this activity.

[The information follows:]

Statement of
The Honorable John H. Gibbons, Director
Office of Science and Technology Policy

before the

Subcommittee on Veterans' Administration, HUD, and Independent Agencies
Committee on Appropriations
U.S. House of Representatives

March 29, 1993

Mr. Chairman, Members of the Committee, I am pleased to appear before you for the first time as Director of the Office of Science and Technology Policy (OSTP). I will present testimony on OSTP's budget request for Fiscal Year 1994. I will also provide a brief overview of six initiatives of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), which I chair, and of the President's technology initiative, Technology for America's Economic Growth: A New Direction to Build Economic Strength, in which OSTP played a key development role and continues to play a leadership role.

OSTP BUDGET REQUEST

The Clinton Administration believes that investing in science and technology is investing in America's future: a growing economy with more high-skill, high-wage jobs for American workers; a cleaner environment where, for example, energy efficiency increases profits and reduces pollution; a stronger, more competitive private sector able to maintain U.S. leadership in critical world markets; an educational system where every student is challenged to reach his or her full potential; and an inspired scientific and technological research community focused on ensuring not just our national security but our very quality of life. The most important measure of success of the Federal initiatives will be our ability to make a difference in the lives of the American people, to support science and direct technology so they improve the quality of life and the economic strength of our nation.

The Office of Science and Technology Policy, created by the National Science and Technology Policy, Organization, and Priorities Act of 1976 (P.L. 94-282), coordinates science and technology policy for the White House. OSTP supports the Administration's objectives by: providing authoritative scientific and technological information, analysis, and advice for the President, for the Executive Branch, and for Congress; participating in formulation, coordination, and implementation of national and international policies and programs that involve science and technology; maintaining and promoting the health and vitality of the U.S. science and technology infrastructure; and coordinating research and development efforts of the Federal government to maximize the return on the public's investment in science and technology and to ensure Federal resources are used efficiently and appropriately.

The total FY 1994 budget request of $5,170,000 is intended to support 40 professional and support staff for OSTP and 6 detailees. The request provides for four Associate Directors -- the number authorized in the enabling legislation. The FY 1994 request also provides for an estimated 7 assistant directors and several policy analysts, consistent with the current OSTP staffing configuration. The professional staff will be composed of individuals with diverse skills, multiple advanced degrees, and broad experience. This is essential, given the number and variety of issues addressed by OSTP and the changes in emphasis from year to year. OSTP also utilizes detailees from other agencies to fulfill staffing needs in specialized science and technology areas.

The total OSTP budget request for FY 1994 provides a base of support that will allow OSTP to fulfill its growing responsibilities related to Administration programs, policies, and initiatives involving science and technology, including:

- Making recommendations to the President and his staff on current major issues of science and technology policy. This requires a very high level of participation and interaction by OSTP with numerous coordinating groups within the Executive Office of the President and with all Federal departments and agencies.

- Directing and coordinating the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) and its committees and subgroups. This requires an intensive level of participation, coordination, and guidance by OSTP staff on the various FCCSET committees and subgroups.

- Coordinating the science and technology elements of the programs of Federal agencies and departments.

- Prioritizing and coordinating the different objectives of the Nation's civil, military, and commercial space activities and developing policies that are in the broad national interest (a new responsibility formerly carried out by the National Space Council).

- Anticipating new science and technology issues, or issues with a significant science and technology component, especially those with a longer-range perspective, and initiating interagency coordination on such issues.

- In consultation with the Department of State, developing, planning, and implementing international bilateral science and technology agreements with foreign countries. Interagency coordination, under FCCSET, of science and technology issues in negotiated agreements with foreign countries.

- Preparing reports in accordance with legislative requests or direction.

- Interacting with various science and technology related groups outside of the Federal Government.

The responsibilities of the Assistant to the President for Science and Technology and of OSTP have increased in the Clinton Administration. Significant additions to OSTP's responsibilities include:

- The Director of OSTP, as Assistant to the President for Science and Technology, plays an active role in the newly formed National Economic Council.

- OSTP has been directed to complete absorption of the essential functions of the National Space Council and the National Critical Materials Council by the beginning of Fiscal Year 1994. OSTP specific responsibility within the Executive Office of the President will include: review of United States Government space policy, including long-range goals and development of a strategy for national space activities; development of recommendations for the President on space policy and space-related issues; monitoring and coordination of implementation of the objectives of the President's national space policy by Executive Departments and agencies; and fostering close coordination, cooperation, and technology and information exchange among the civil, national security, and commercial space sectors, and facilitating resolution of differences concerning major space and space-related policy issues. In addition, OSTP will take the lead role in: assisting the President in establishing coherent national materials policies; coordinating Federal materials-related policies, programs, and research and technology activities; and reviewing and appraising the various programs and activities of the Federal government in accordance with the policy and directions given in the National Materials and Minerals Policy, Research, and Development Act of 1980.

- Under the President's investment plan, OSTP has assumed additional responsibilities in science and mathematics education, the environment, high performance computing and communications, biotechnology, materials science, and technology, particularly as it affects global competitiveness.

- The Director of OSTP chairs FCCSET, which will have an expanded mission and augmented role in the new Administration.

In Fiscal Year 1994, OSTP requests an increase in funding of $945,000 over Fiscal Year 1993 (excluding consideration of $2 million provided to the Consortium for International Earth Science Information Network (CIESIN) through OSTP in FY '93). Growth in personnel compensation -- pay and benefits -- largely accounts for the requested increase. This growth is occasioned by the transition from reliance on detailees during the previous Administration to reliance on full-time equivalent staff (FTEs) and hiring up to OSTP's permitted strength of 40 positions. OSTP hopes to have a more stable staff in place for Fiscal Year 1994 (and beyond) than has been the case in prior years.

We have also requested an increase in the funds available for consulting services. Since OSTP is limited in the number of detailees that can be borrowed from other agencies, we will depend on contracts for specialized deliverables to fill short-term, highly technical information needs. This type of contracting to complement staff capabilities served the Congressional Office of Technology Assessment very well during my years as Director there, and I believe it can be used to very good effect at OSTP as well.

OSTP has a critical role to play in coordinating science and technology policy for the Executive Branch. The performance of the Office will be enhanced by greater stability in the permanent staff coupled with better access to specialized, "cutting edge" information needed on a quick turn-around, short-term basis. The budget requested for Fiscal Year 1994 would support these needs. I hope the following descriptions of two important OSTP functions -- chairmanship of FCCSET and leadership on implementing the technology initiative -- will help you to appreciate OSTP's role and to support this level of funding.

FCCSET INITIATIVES

The Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) plays an essential role in developing and implementing U.S. science and technology policy. Chaired by the Director of OSTP, FCCSET is charged with:

- Providing more effective planning, integration, and coordination of Federal scientific, engineering, educational, and technological programs;

- Achieving more effective utilization of the scientific, engineering, educational, and technological resources and facilities of Federal agencies;

- Involving individuals, universities, and companies from the non-Federal sector in addressing the interaction of the Federal government and the private sector on scientific, engineering, educational, and technological issues; and

-- Furthering international cooperation in science, engineering, and technology.

The agencies participating in FCCSET, in conjunction with OSTP and the Office of Management and Budget, have undertaken crosscutting analyses of all Federal activities in 6 specific areas of science and technology. FCCSET performed an inventory of current agency activities in these areas and fashioned coordinated Federal strategies with long-range goals and priorities. These FCCSET initiatives, described below, address issues of great importance to national needs and objectives. The agencies involved in FCCSET deserve special recognition for their efforts in these critical areas.

Biotechnology Research

Biotechnology offers novel approaches to understanding and solving some of the world's greatest problems, including disease, hunger, and pollution. The goal of the Biotechnology Research initiative is to sustain and extend U.S. leadership in biotechnology research for the 21st Century, to enhance the quality of life for all Americans, and to spur the growth of the U.S. economy.

Twelve Federal agencies participate in this FCCSET initiative: the Departments of Health and Human Services (DHHS), Agriculture (USDA), Commerce (DOC), Defense (DoD), Energy (DOE), Interior (DOI), Justice (DOJ), and Veterans' Affairs (VA), and the Agency for International Development (AID), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF). Working together, these agencies have chosen 6 major areas of biotechnology research for tracking and analysis: 1) human health; 2) environment; 3) agriculture; 4) energy; 5) general foundations; and 6) manufacturing and bioprocessing. We are now in a period in which Federal funding can catalyze the development of key advances for more effective means of disease diagnosis and treatment and of environmental protection and restoration. Each area of biotechnology research has knowledge gaps that, if not addressed, will impede progress in this critical area.

High Performance Computing and Communications (HPCC)

The agencies participating in the HPCC Program are creating a single, integrated, nationwide infrastructure for high performance computing and communications and for information technology. The goal of this Program is to facilitate the development of computing, communications, and software infrastructure to serve the national economy and security, spur gains in U.S. productivity and industrial competitiveness, and improve the health and education of the U.S. population.

Participants -- DoD's Advanced Research Projects Agency (ARPA) and National Security Agency (NSA), NSF, DOE, NASA, DOC's National Oceanic and Atmospheric Administration (NOAA) and National Institute of Standards and Technology (NIST), and EPA -- coordinate their activities in order to leverage efforts in areas of common need and mission overlap. No individual agency has either the mission or the expertise to develop all components of a national information infrastructure, but each agency plays a necessary and complementary role.

Development of a national information infrastructure (NII) received special attention in the President's technology initiative, and the participants in the HPCC Program will support the NII with the following activities:

-- Broadening the reach of the HPCC computing and communications infrastructure to include access by medical facilities, libraries, education institutions, and industry throughout the United States;

-- Demonstrating the potential of advanced applications of software in improving health care, manufacturing, energy use, and the environment; and

-- Improving education and lifelong learning, including facilitating establishment of digital libraries and providing for appropriate privacy and security protections.

Science, Mathematics, Engineering, and Technology Education (SMETE)

The goal of the SMETE initiative is to ensure the health and wellbeing of science, mathematics, engineering, and technology education at all levels and in all sectors. Eleven agencies -- DOC, DoD, DOE, DOI, EPA, DHHS, NASA, NSF, USDA, the Department of Education (ED), and the Smithsonian Institution (SI) -- participate in this initiative, and they have established priorities and milestones in areas of responsibility from kindergarten through postgraduate education, as well as public understanding of science and technology education. The participants carefully monitor progress toward achieving the milestones and work toward ensuring interagency coordination and communication.

In support of the President's efforts to improve math and science education, SMETE will address:

-- Elementary and secondary system reform, by attempting to foster standards-based systemic reform through an approach that incorporates ambitious content standards for all students, curriculum, in-service training, teacher preparation programs, and assessments linked to those standards;

- Undergraduate revitalization, by supporting curriculum revisions, providing undergraduate faculty with research experience, and providing student financial assistance;
- Graduate education, by continuing to provide pre- and post-doctoral student support;
- Public understanding of science, by supporting programs designed to increase the ability of adults to make informed choices on science-related issues;
- Technical education, by supporting efforts to improve the school-to-work transition and ensuring that all workers receive the training necessary to keep pace with a rapidly changing economy; and
- Technology transfer, particularly by assisting in the transfer of military expertise in education and training to the civilian sector.

The participants in this initiative have identified several crosscutting priorities to be addressed in Fiscal Year 1994 and beyond, including: increasing the use of educational technology; increasing participation of underrepresented groups; identification and dissemination of exemplary materials; and evaluation.

Global Change Research

The goal of the U.S. Global Change Research Program (USGCRP) is to gain a better understanding of the interactive physical, geological, chemical, biological, economic, and social processes that regulate the total Earth system. Such an understanding will help establish a scientific basis for national and international policy formulation and action.

To fulfill the goals and address the strategic priorities of the USGCRP, 4 parallel but interconnected streams of national and international activity have been developed:

- Observations and data management: the establishment of an integrated, comprehensive, long-term program of Earth system observations and data management on a global scale;
- Process research: the development of a program of focused studies to improve knowledge of the physical, geological, chemical, biological, and

social processes that influence and govern Earth system behavior and our knowledge of the impact of global change on human health and activities;

- Integrated modeling and prediction: the development and application of integrated conceptual and predictive Earth system models; and

- Assessments: the documentation and assessment of the state of scientific knowledge and uncertainties and the implications of the science of global change to support national and international policymaking activities over a broad spectrum of global and regional environmental issues.

The USGCRP maintains a formal mechanism to coordinate the interests of industry, business, commerce, and nongovernmental environmental groups with Federal participants (DOC, DoD, DOE, DOI, EPA, DHHS, NASA, NSF, SI, USDA, and the Tennessee Valley Authority (TVA)).

Advanced Manufacturing Technology (AMT)

Manufacturing is the foundation of the U.S. economy. Private industry must define and develop new manufacturing technologies and put them to use on the factory floor, but the Federal Government can facilitate this process by supporting R&D involving precompetitive, generic fabrication and manufacturing technologies and by providing appropriate mechanisms to accelerate successful technology deployment, particularly among smaller manufacturers. The participants in AMT -- DOC, DoD, DOE, DOI, EPA, NASA, NSF, and USDA -- have established the following goal: to accelerate the development and application of advanced manufacturing technologies to dramatically improve the manufacturing capabilities of a broad spectrum of U.S. industries. The goal will be accomplished by developing a coherent and synergistic interagency program in advanced manufacturing technology R&D and by combining and integrating Federal efforts in cooperation with the States and other stakeholders.

AMT participants focus their efforts in 4 broad categories:

- Manufacturing design technologies, including tools and techniques used to prepare for manufacturing;

- Manufacturing technologies, including processes and equipment used for the actual production of physical products;

- Supporting technologies, including underlying core technologies needed to provide advances in design and manufacturing technologies; and
- Manufacturing infrastructure elements, including concepts and mechanisms for managing the development of appropriate technologies and for encouraging their widespread use within the industrial base.

AMT will have a major role in coordinating the Federal Government's contribution to development and deployment of a new generation of automobiles, part of the President's technology initiative.

Advanced Materials and Processing Program (AMPP)

The goal of the AMPP is to improve the manufacture and performance of materials to enhance the Nation's quality of life, security, industrial productivity, and economic growth. To achieve this overall goal, programs are designed in accordance with 4 strategic objectives, which concern broad national needs:

- Establish and maintain the U.S. scientific and technological leadership position in advanced materials and processing;
- Bridge the gap between innovation and commercial application of advanced materials technologies;
- Support agencies' mission objectives to meet national needs with improvements in advanced materials and processing; and
- Encourage university and private-sector R&D activities in materials technologies, their applications, and their implementation.

Each participating agency focuses on aspects of materials R&D relevant to the agency's missions and cooperates with other agencies in areas of common interest. The 10 participating agencies are DOC, DoD, DOE, DOI, the Department of Transportation (DOT), EPA, DHHS, NASA, NSF, and USDA.

THE TECHNOLOGY INITIATIVE

The President has directed OSTP to assume a leadership role in implementing his technology initiative, described in Technology for America's Economic Growth: A New Direction to Build Economic Strength. This initiative, introduced February 22, 1993, offers a comprehensive blueprint to focus American technology on 3 central goals:

- Long-term economic growth that creates jobs and protects the environment;
- Making government more efficient and more responsive;
- World leadership in basic science, mathematics, and engineering.

We are moving in a new direction that recognizes the critical role technology must play in stimulating and sustaining the long-term economic growth that creates high-quality jobs and protects our environment. The traditional federal role in technology development has been limited to support of basic science and mission-oriented research in, primarily, the Defense Department and NASA. This strategy was appropriate for a previous generation, but not for today's profoundly different challenges. We cannot rely on the serendipitous application of defense technology to the private sector. We must aim more directly at our goals and focus our efforts on the new opportunities before us, recognizing that government can play a key role in enabling private firms to develop and profit from innovations.

With this initiative, we take a critical step toward ensuring that the federal investment in science and technology becomes a key instrument for promoting U.S. economic growth and for satisfying other national goals. We must approach these interrelated goals in an integrated fashion to take full advantage of the opportunities presented by new technologies.

Goal: Long-Term Economic Growth that Creates Jobs and Protects the Environment

Technology drives economic growth. Advances in technology created two-thirds of the productivity growth in the United States over the past 60 years. The knowledge-based, growth industries of the future depend on continuous generation of new technological innovations and rapid transformation of those innovations into marketable products. We can promote technology as a catalyst for economic growth by:

> Directly supporting the development, commercialization, and deployment of new technology. The nation urgently needs improved strategies for government/industry cooperation in the support of industrial technology. We cannot afford to wait for investments in defense and space to trickle down to civilian industry. Commercial R&D will be enhanced by the President's plan to: increase the civilian share of the R&D budget to more than 50% by 1998; expand the Commerce Department's Advanced Technology Program; emphasize dual use technologies in the renamed Advanced Research Projects Agency; encourage industry consortia to advance critical technologies, including "green" technologies that reduce pollution and manufacturing waste; make partnerships with industry -- through Cooperative R&D Agreements (CRADAs) and other mechanisms -- high priorities in the federal agencies and their laboratories; and improve interagency cooperation by

strengthening the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET).

The federal government needs to promote an atmosphere in which U.S. firms can excel equally at inventing new technologies, a historical strength, and commercializing new products, the area of toughest foreign competition. Easy access to existing technologies and best practice information -- through agricultural extension centers -- engendered the extraordinary productivity gains in American farming throughout this century. Our hope for future economic growth lies in providing the same opportunities to American manufacturers. Access to and deployment of technology will be enhanced by the President's plan, which includes a national network of manufacturing extension centers.

Creating a world-class business environment for innovation and private sector investment. Capital and technology know no national boundaries. To compete for industrial and technological leadership, and for high-wage, high-skill jobs for American workers, the United States must create an environment that invites private sector investment and job creation. We must ensure that our tax, trade, regulatory, and procurement policies support this objective. The business climate will be enhanced by the President's plan to: make permanent the research and experimentation (R&E) tax credit; provide incentives for individuals making high-risk, long-term venture capital investments in startups and other small enterprises; stimulate additional investment in equipment by providing a temporary incremental investment tax credit for large businesses and a permanent credit for small businesses; reform antitrust laws to permit joint production ventures; secure full access to overseas markets and effective protection of intellectual property rights through U.S. trade policy; and review the nation's regulatory "infrastructure" to ensure that unnecessary obstacles to technical innovation are removed.

Investing in life-long learning. Americans must have access to the education and training they need to compete in the world economy and live satisfying lives. To provide this level of access, it will be necessary to restructure primary and secondary schooling, to use youth apprenticeships and other programs to facilitate the transition from school to work for people who do not expect to go to college, to make training accessible and affordable for workers who must upgrade their skills to keep pace with rapid economic changes, and to target workers displaced by declining defense budgets or increased international trade. We intend to use new technology to increase the productivity of learning in all environments, make instruction and resources available to schools, businesses, and homes throughout America, and turn the schools into high-performance workplaces. Our programs will help ensure that all students are well trained in math, science, and engineering, particularly students in minority communities. We will exploit our investment in defense education and training for applications in the civilian economy. Education and training will be enhanced by the President's plan to: provide university campuses, community colleges, and K-12 schools access to a high-speed communications network through the Internet and the National Research and Education Network (NREN); adopt software and communication standards for education and training; support comprehensive systemic reform, including high standards curriculum redesign, teacher training, improved assessments, and enhanced accountability for results. We will also encourage industry consortia and regional alliances to develop new teaching systems; and provide matching funds for graduate or undergraduate programs in manufacturing engineering.

Supporting information superhighways. American businesses gain a competitive edge through efficient access to information. Many more businesses can join the banks, insurance companies, and manufacturing concerns who now use high-speed communication links if the systems are reliable, easy to use, and inexpensive. Accelerating the introduction of an efficient, high-speed communications system can have the same effect on U.S. economic and social development as investment in the railroads had in the 19th century. The reach of the "information superhighways" will be enhanced by the President's plan to: implement the programs established by the High-Performance Computing Act of 1991, introduced by the Vice President when he served in the Senate; work with Congress and the private sector to develop a consensus and eliminate the government regulations that have tended to inhibit competition and delay deployment of new telecommunications and computer technology; assist industry in the development of the hardware and software needed to fully apply advanced computing and networking technology in manufacturing, in health care, in life-long learning, and in libraries through a new Information Infrastructure Technology Program; provide funding for networking pilot projects through the National Telecommunications and Information Administration; and promote broad dissemination of federal information at a fair price. The budget proposes over $1 billion of investments in this area.

Upgrading the transportation infrastructure. A competitive, growing economy requires a transportation system to move people, goods, and services quickly and efficiently. A strategic program to develop new technologies for assessing the physical condition of the nation's infrastructure, together with techniques to repair and rehabilitate those structures, could lead to more cost-effective maintenance of the infrastructure necessary for economic growth. The transportation sector will be enhanced by the President's plan to: improve services and facilities by providing additional funding authorized by the Intermodal Surface Transportation Efficiency Act of 1991; provide funds for research on high speed rail transportation; increase research on new technologies leading toward development of "smart highways" that provide in-route planning and traffic monitoring; increase research on civil aviation technologies, particularly on systems for in-flight space and ground-based command, navigation, and weather prediction; minimize the frequency of costly reconstruction by increasing research on new materials that will allow the construction of more durable infrastructure facilities; and explore new assessment technologies for more accurately assessing the expected life of existing public infrastructure. The budget proposes over $2 billion in this area, a substantial increase of 1993.

Goal: Making Government More Efficient and More Responsive

Present circumstances demand that we use technology to reinvent government -- to make it work better, quicker, smarter, and cheaper. The federal government lags behind the private sector in use of advanced communications systems and in adoption of energy efficiency technologies. The taxpayers foot the bill for these inefficiencies. The federal government is also wasting opportunities by failing to use its enormous purchasing power to stimulate markets for innovative products. The federal government can become more responsive to the needs of its clients by:

Making better use of information technology. Government can become more cost-effective, efficient, and "user-friendly" through the use of information technology. Fast communication makes it possible for teams to work closely on a project even if team members are physically distant from one another, which presents an opportunity to flatten existing organizational structure, form effective cross-disciplinary problem-solving groups, and expand the definition of the workplace and workforce. Often, though, efficiency gains from the new technology can only be captured if changes are made in the structure of organizations and the way they are managed. The Federal Government spends over $26 billion annually on information technologies and services. Thus Federal use of these technologies can have a significant influence on the information technology market and can improve quality and timeliness of service and improve access to government information. Because of all these factors, information technology plays a key role in the President's program to make government more efficient.

Operating energy-efficient buildings. The federal government is wasting tax dollars by operating inefficient buildings. California, Texas, Iowa, and several other States have successful programs that have profitably invested in buildings during the past several years. These programs have increased the efficiency of State structures and stimulated the local construction industries. In his effort to learn from the States and improve the use of tax dollars, the President will emphasize investments in energy retrofits that have short payback periods: for instance, the budget includes

$2 billion over the next 5 years for energy retrofits in federal buildings that we expect will have an average payback time of about 5 years; and some of the $3-4 billion a year that HUD spends subsidizing the energy bills of 5 million low income households (about 7 percent, or $200-300 million) could be invested in energy retrofits that would pay back in less than 5 years and represent a lasting decrease in energy bills.

Reforming procurement policy. The enormous purchasing power of the federal government has often played a key role in ensuring early markets for innovative technologies. An accretion of complex regulations governing procurement, however, has made it difficult for the government to purchase cost-competitive commercial products or to stimulate markets for innovative products as a matter of policy. We will work to eliminate these problems to ensure that the taxpayers get their money's worth from federal purchases. We will develop purchasing procedures that give priority to advanced commercial products whenever they are justified on the basis of life-cycle costs (including environmental, health, and safety costs). Where appropriate, we will also try to create markets for technologies likely to have significant economic or social benefits. Contracting procedures will be designed to ensure that commercial firms are given the opportunity to propose innovative responses to federal requests and to retain rights in technologies developed.

Goal: World Leadership in Basic Science, Mathematics, and Engineering

Our basic science program provides the foundation for new technologies, and vice versa. The federal government has invested heavily in basic research since the Second World War, and this support has paid enormous dividends. Our research universities are the best in the world; our research universities, our national laboratories, and our research facilities attract students, scientists, and engineers from around the globe. In almost every field, U.S. researchers lead their foreign colleagues in scientific citations, in Nobel Prizes, and in most other measures of scientific excellence. This preeminent position is of inestimable value and merits strong, sustained support.

While we emphasize technology in the President's initiative, none of the innovations proposed will be funded at the expense of basic science. Our proposal ensures that support for basic science remains strong and that stable funding is provided for projects that require continuity. We must not allow short term fluctuations in funding levels to destroy critical research activities that have taken years to assemble.

But stable funding requires clear priorities and periodic reevaluation. In recent years, rather than phasing out less important projects when research budgets have been tight, Federal agencies have tended to spread the pain, resulting in disruptive cuts and associated schedule delays in hundreds of programs. Improved management of basic science can ensure sustained support for high-priority programs, including:

University research. The National Science Foundation (NSF) and the National Institutes of Health (NIH) provide the vast majority of federal funding for university research. Since universities play dual roles of research and teaching, the long-term scientific and technological vitality of the U.S. depends upon adequate and sustained funding for university research grant programs at NSF, NIH, and other research agencies.

National laboratories. In high-energy physics, biomedical science, nuclear physics, environmental and materials sciences, aeronautics, and other fields, the national laboratories provide key facilities used by their own researchers and those in academia and industry. In many fields, researchers at federal labs are world leaders. We will ensure that federal laboratories continue their key role in basic research but will encourage more cooperative research between the laboratories, industries, and universities. And we will develop new missions for our federal labs to make full use of the talented and experienced men and women working there in today's post-Cold War era with its emphasis on jobs, economy, and environment.

Space science and exploration. Space research and exploration programs constitute an important component of the nation's overall science and technology effort. Given the competing demands for scarce national resources, these programs require design and management that ensure maximum return on our investment. One way to accomplish this is through carefully crafted cooperation with international partners, virtually all of whom are also experiencing budgetary pressures. We must explore all reasonable means of working with them to use our collective resources more efficiently.

Environmental research. The federal government will invest in research to better understand global climate factors, ozone depletion, and other phenomena important to local, regional, and global environments. This research is essential if we are to fully assess the damage humankind is doing to our planet and take effective action to address it. Vital research on local and regional environmental problems will also be strongly supported at EPA, NOAA, NSF, DOE, NASA, DoD, DOL, USDA, and other agencies.

The plan embodied in Technology for America's Economic Growth represents a major departure from the programs of the past. Organized around broad, national goals, it abandons the notion that we can depend on spin-offs from space and defense R&D for future wellbeing and adopts an ambitious, integrated approach to civil and defense R&D spending in order to ensure national, economic, and environmental security.

Redirecting America's programs in science and technology will require major changes in the way we manage our efforts, and change is underway:

-- Working with Vice President Gore, a reinvigorated Office of Science and Technology Policy will lead the development of science and technology policy and will use the FCCSET as one tool in coordinating the R&D programs of the federal agencies.

-- The new National Economic Council will monitor the implementation of new policies and provide a forum for coordinating technology policy with tax, trade, regulatory, economic development and other policies.

Other changes will require the cooperation of Congress. For instance, we will conduct a review of laws and regulations, such as the Federal Advisory Committee Act and conflict of interest laws, to determine whether changes are needed to increase the ability of government and industry to communicate and cooperate. We also intend to work closely with you, Mr. Chairman, and others in Congress to prevent inappropriate "earmarking" of funds for science and technology. We believe that peer review and merit-based competition are critical to the success of any science and technology program.

If this plan succeeds, we will experience fundamental change in the way we live and work. The technology initiative incorporates valuable existing programs, but steps forward in important new directions. I would like to highlight 6 new initiatives outlined in Technology for America's Economic Growth that hold great promise for enabling the future:

Extend Permanently the Research and Experimentation Tax Credit. Our economic goals demand private sector investment in research. Yet businesses lack incentives to make such investments. The Administration will propose that the Research and Experimentation Tax Credit be made permanent. The credit would apply to qualified research expenditures by businesses and to business expenditures for university basic research paid or incurred after June 30, 1992. The proposal will also provide a basis for startup businesses to qualify for the credit.

Invest in an Information Infrastructure. The interstate highway system reoriented American commerce. "Information Superhighways" -- able to move ideas, data, and images around the country and around the world -- will have a similarly positive effect on U.S. competitiveness and economic strength. The Administration will initiate a package of programs -- e.g., implementation of the High-Performance Computing and Communications Program; creation of a Task Force on Information Infrastructure; creation of an Information Infrastructure Technology Program; provision of funding for networking pilot projects; and promotion of dissemination of federal information -- to ensure that the nation adopts forward-looking policies that promote the development of new technologies that will create the information infrastructure needed for the 21st Century.

Promote Advanced Manufacturing Technology. The 360,000 small- and medium-sized manufacturers in the United States, who employ 8 million workers, lack the resources and ability to gain access to the technologies that will help them grow, increase their profits, and create jobs. The Administration will work to remedy that problem by: providing increased funding for advanced manufacturing R&D; supporting agile manufacturing, which allows independently-owned companies to form instantaneous partnerships with firms that have complementary capabilities in order to exploit market opportunities; creating a national network of manufacturing extension centers, which will ensure that small- and medium-sized firms know about and use new technologies and best practice information; seeding regional technology alliances, to encourage firms and research institutions in a particular region to exchange information, share and develop technology, and develop new products and markets; promoting manufacturing engineering education, to end the years of neglect of the management and operation of manufacturing activities; and encouraging environmentally-conscious manufacturing, to illuminate the fact that energy efficient and waste minimization technologies save money and improve the economy.

Facilitate Private Sector Development of a New Generation of Automobiles. America needs a strong automobile industry. Given adequate investment in R&D, a new generation of safe, high-performance automobiles designed to consume domestic fuels and produce little or no pollution could be brought to market -- preserving jobs, increasing the market share of American firms, and expanding U.S. economic growth. The Administration proposes a bold initiative, including: a "clean car" task force linking research efforts of relevant agencies, national laboratories, and defense facilities with those of U.S. auto manufacturers; involving key State officials in a special advisory group to the task force that will 1) design a program for using the authority already present in the Clean Air Act revision of 1991 and the National Energy Act of 1992 to encourage introduction of prototype vehicles consistent with the objectives of this program, 2) coordinate state regulatory programs designed to require low or zero emissions vehicles, 3) propose federal regulations needed to supplement State efforts, and 4) design programs for managing federal vehicle procurement.

Improve Technology for Education and Training. Many Americans leave school ill-equipped to enter the high-tech workforce of today or even to put new scientific and technological innovations to work for themselves. To enable the life-long learning process essential to productive and satisfying lives, the Administration proposes to: expand access to the Internet and NREN, to provide a broad range of information resources to universities and K-12 schools; facilitate development of software and communication standards for education and training; improve Federal programs designed to improve the teaching of science, math, and engineering at all levels; work with industry consortia and training organizations across the nation to develop, install, and maintain state-of-the-art teaching systems; and promote manufacturing engineering education.

Make Energy Efficiency Investments in Federal Buildings. The government has to stop throwing away taxpayer dollars on needless energy expenditures. The Administration proposes to increase the efficiency of government by making cost-effective investments in buildings where the energy bills are paid by the taxpayers.

This technology initiative captures the Clinton Administration's vision of the power of technology to improve our economy and citizens' lives. The best technology policy unleashes the creative energies of innovators throughout the economy.

CONCLUSION

Growth in OSTP's responsibilities corresponds with growth in the importance of science and technology in many areas of national policy. Given the continuing challenges to the Nation in OSTP's areas of responsibility, I hope you will support our budget request of $5.17 million.

The President has adopted an aggressive stance on the direction of science and technology toward solving national problems and achieving national goals. As my testimony described, R&D funds will be invested in areas that will boost productivity and improve economic performance as well as in areas that ensure the United States maintains its leadership in basic science. The science and technology budget lays the groundwork for economic growth.

I would be happy to answer your questions.

BIOGRAPHICAL SKETCH OF JOHN H. GIBBONS

Dr. John H. (Jack) Gibbons took the oath of office as Assistant to the President for Science and Technology and Director, Office of Science and Technology Policy, on February 2, 1993. In these capacities, Dr. Gibbons is charged with providing access to authoritative information and expert scientific, engineering and technological advice for the President, Federal Officials, and Congress, and with coordinating science and technology policy throughout the Federal Government.

Prior to his appointment by President Clinton and since 1979, Dr. Gibbons directed the Congressional Office of Technology Assessment (OTA).

Congress authorized OTA in 1972 to provide itself with a source of information that is nonpartisan, expert, objective, and anticipatory. OTA prepares comprehensive analyses on a broad spectrum of complex and controversial issues involving technology and public policy. Subjects of some recently completed studies include: defense and industrial base technology; testing in American schools; computer software and intellectual property; energy technologies for developing countries; forest service planning; cystic fibrosis and DNA tests; new agriculture technology; police body armor; biological basis of mental illness; "green" materials technology; auto fuel economy and retiring old cars; and United States-Mexico trade, technology and development.

Dr. Gibbons is an internationally recognized scientist, an expert in energy and environmental issues, and a man with a deep interest and concern regarding the impacts of technology on society and what these impacts imply for the formulation of sound public policy. Before his congressional appointment, Dr. Gibbons served as the Director of Energy, Environment, and Resources Center at the University of Tennessee. Prior to that, at the Oak Ridge National Laboratory, he conducted physics research and later directed projects on energy and materials conservation and on the environmental consequences of power production. In 1973-1974, as the first Director of Energy Conservation for the Federal Energy Administration, he initiated and directed overall Federal programs in research, development, and demonstration on energy conservation.

His past public sector advisory activities have included chairmanship of the Demand/Conservation Panel for the National Academy of Sciences Committee on Nuclear and Alternative Energy Systems (CONAES) and membership on the Energy Research Advisory Board of the U.S. Department of Energy. He has served on the Board of Trustees and Board of Associates of Randolph-Macon College, the Board on Science and Technology for International Development (BOSTID) of the National Academy of Sciences, the Board of the American Association for the Advancement of Science, and the Board of Resources for the Future. He has also served on the Electric Power Research Institute (EPRI) Advisory Council; the Long-Range Planning Committee of Sigma Xi; the Aspen Institute/Energy and Resources Committee; the Carnegie Commission on Science, Technology and Government Task Force on Long-Term Goals and Priorities; and the Board of the Energy Foundation.

Dr. Gibbons is a graduate of Randolph-Macon College and Duke University (Ph.D., Physics). He is a Fellow of the American Physical Society and the American Association for the Advancement of Science, and is a member of the Council on Foreign Relations.

In 1990, Dr. Gibbons received the Federation of American Scientists Public Service Award; in 1991, the American Physical Society Leo Szilard Award for Physics in the Public Interest. The President of Germany has awarded Dr. Gibbons the Officer's Cross of the Order of Merit to recognize his contributions to German-American cooperation in science and technology.

Subjects of his publications range from experimental nuclear physics to the influence of energy price and technology on future energy demand.

March 1993

BIOGRAPHY OF LIONEL SKIPWITH JOHNS

Mr. Johns is the senior of three Assistant Director's of the Office of Technology Assessment (OTA) in Washington, D.C. OTA was established by the U.S. Congress in 1972 as a non-partisan support agency to provide, at the request of Congressional committees, objective analysis of major public issues related to scientific and technological change.

Mr. Johns came to OTA in 1975 and was responsible for forming and managing the Energy Program. In 1978 he was named Assistant Director of the Energy, Materials, and International Security Division. Under his direction more than 100 assessments have been submitted to Congress on such diverse issues as MX missile basing, effects of nuclear war, technology and Soviet energy availability, U.S. vulnerability to an oil import curtailment, industrial and commercial cogeneration, international cooperation and competition in civilian space activities, technology transfer to China, and ballistic missile defense technologies. Most recently, a series of reports on the U.S. work force, transitions of the U.S. economy and U.S. competitiveness and trade issues have dominated his program agenda. Mr. Johns and his program staff testify before Congressional committees on these and other issues, and provide briefings for members of Congress and their staffs.

Mr. Johns came to OTA with experience in the management of high technology industries and corporate finance. He was a corporate finance representative of the investment banking firm, Alex Brown & Sons, and was Eastern Regional Manager and Director of Corporate Marketing for Oceans Science and Engineering, Inc. (OSE). Prior to joining OSE, Mr. Johns worked for five years as Project Engineer for Hazeltine and the Magnavox Company on projects involving the design, development and production of radar, communications, sonar and command and control equipment.

Mr. Johns has represented OTA at numerous meetings on arms control, energy, trade, and Third World Development in Asia, Europe, and Africa. Some of the sponsors of these meetings were the U.S., The Netherlands, East and West Germany, and Japan; the United Nations and private organizations. He most recently served on the steering committee of Sigma Xi to help select the agenda for that organization of scientists on what issues should be addressed by the United States at the Environment and Development Conference this year in Brazil.

In June 1985 Mr. Johns was elected as a Fellow of the American Association for the Advancement of Science. He served as a member of the Committee on Population, Resources and the Environment and as Chairman of its sub-committee on technical change.

Mr. Johns received a B.S. degree in Corporate Finance from the University of Virginia and served as an aviator in the United States Navy.

KARL A. ERB

Karl A. Erb is the Associate Director for Physical Sciences and Engineering of the White House Office of Science and Technology Policy. He was nominated for this position by President Bush on March 26, 1992 and confirmed by the Senate on June 19. Prior to his present appointment, he was Acting Associate Director (10/91-6/92) and Assistant Director (1989-1991) in this Directorate.

Dr. Erb was detailed to the White House Office of Science and Technology Policy in 1989 from the National Science Foundation, where he was Deputy Director of the Division of Physics and a member of the Federal Career Senior Executive Service. He joined NSF in 1986 as the Director of the Nuclear Physics Program. From 1987 to 1989, Dr. Erb was the Federal official responsible for the DOE/NSF Nuclear Science Advisory Committee.

Dr. Erb, a 1965 graduate of New York University, received his Ph.D. in Physics from the University of Michigan in 1970. He joined the University of Pittsburgh in that year as an Instructor and Research Associate in experimental nuclear physics. In 1972, he joined the Yale University faculty, serving subsequently as Instructor, Assistant Professor, and Associate Professor of Physics, and conducted research with his students as a member of the university's Wright Nuclear Structure Laboratory. Dr. Erb then moved to the Oak Ridge National Laboratory as Staff Scientist in 1980 and subsequently became the Technical Assistant to the Associate ORNL Director for Physical Sciences.

Dr. Erb's research has centered on experimental nuclear physics, particularly in the areas of heavy-ion science and nuclear molecular phenomena and accelerator technology. He has served on a variety of review, advisory, and visiting committees, and from 1982 to 1985 was a member of the DOE/NSF Nuclear Science Advisory Committee.

June 1992

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Dr. Erb is currently serving as Acting Associate Director for Physical Sciences and Engineering assisting in the transition.

January 1993

RICHARD DALBELLO

Since February 1993, Richard DalBello has been the Special Assistant for Space within the Office of Science and Technology Policy.

Prior to joining OSTP, Mr. DalBello was the Director of the Commercial Satellite Communications and Remote Sensing Division within the NASA Office of Commercial Programs. Before joining the Office of Commercial programs, Mr. DalBello was the Director of Policy within the Office of Policy and International Relations.

From January 1989 through March of 1991, Mr. DalBello was the Acting Director of the Office of Space Commerce within the Department of Commerce.

Mr. DalBello was a Senior Analyst and Project Director with the Office of Technology Assessment (OTA) from 1981 through 1989.

BARBARA ANN FERGUSON

Ms. Ferguson joined the Office of Science and Technology Policy (OSTP) as the Administrative Officer in September of 1990. In this position, she is responsible for the OSTP Administrative Office and all matters concerning the budget, financial management, contracting, personnel, security, space, supplies and equipment. In addition, she serves as the agency liaison for Federal Advisory Committee Management, the alternate ethics officer and the Freedom of Information Act coordinator.

Prior to joining OSTP, Ms. Ferguson was the Administrative Support Specialist for the Office of Emergency Operations (OEO) from January 1988 until September 1990. She was responsible for providing administrative/office management support to the Office of Security of the OEO. Ms. Ferguson managed the office budget and assisted the contracting officer representatives in the monitoring of five contracts totalling several million dollars worth of effort. She was responsible for drafting statements of work, drafting contract-related correspondence, and preparing and staffing funding requests in relation to contracts.

From April 1981 to January 1988, Ms. Ferguson worked for JAYCOR, a high-technology research and development firm in Vienna, Virginia. During that time period she served in a variety of functions including being instrumental in the creation of a subsidiary company, JAYCOR Technical Services Company.

Ms. Ferguson worked for the Naval Electronic Systems Command as Personal Secretary to the Program Manager of Command, Control, Communications and Intelligence (C3I) from 1976 to 1980.

Prior to that she worked for the Naval Supply Systems Command from 1974 to 1976.

Ms. Ferguson is a 1972 graduate of the Katharine Gibbs School in Montclair, New Jersey.

ADMINISTRATION'S CHANGE IN DIRECTION

Mr. STOKES. Well, thank you very much, Dr. Gibbons for the presentation.

What we will do is open up with some general questions to you.

You represent now a new administration, a new President who has been given a mandate by the American people for change. I guess our first question to you is what major difference do you see between this administration and the last administration in terms of space and science and technology emphasis?

Mr. GIBBONS. All right, sir. I think as I reviewed my predecessor's colloquy before this committee a year ago, I find a lot of similarity, a lot of interest and conviction. And the sustained support of basic science is a wellspring of new ideas and of new technology that emerges from those ideas. Technology itself is the ultimate wellspring of new options for us, to achieve our national and personal wants.

This kind of public investment in basic science certainly reflects our national tradition of joint venturing as a Nation in exploration of interesting new ideas.

So that, I think, reiterates the last administration's interest, and certainly I concur with it.

I think the—if I look for the differences, it may come in how we approach the notion of the Federal Government, that is the people through the Federal Government, and the private sector through its variation institutions, how we approach each other in terms of common interests.

We have had in times past the notion that the government should be essentially a passive player in this regard and that the market itself will handle the transformation of ideas into the marketplace of goods and services and jobs and the like. And I think the feeling of this administration is that while the market is the ultimate determiner of things, and I have seen this in my own experience, there is a strong self-interest in pulling on the same oars from time to time, such as the example I gave you on the advanced automobile.

Our automobile companies simply are not able to look forward to major investments with the same kind of forward commitment that we as a nation can. And, for instance, the idea of a new automobile that may not be able to get here for 10 or 15 years is out of range for a private sector investment. And yet if it takes 10 to 15 years to get there and if the public is going to benefit very greatly from that venturing, then we have an opportunity to go together on things.

So the notion of building on the success of SEMATECH and the battery consortium and other things that were begun in the latter part of the last administration's time it seems to us is something that is going to pick up and gain more momentum and more support under this administration.

THE SPLIT BETWEEN CIVILIAN AND DEFENSE RESEARCH

I believe also that we are going to see a considerable effort over time to continue to convert our Federal research from a defense-dominated situation to our historic balance of about 50–50 defense versus civil, to perhaps even go farther than that once we spell out what our new environment is in this post–Cold War era.

As you know, things can change almost daily these days, so it is difficult to define exactly what the new paradigm is, but we are committed to see that ratio move as we see it at this point certainly back to a 50–50 split.

I think, finally, Mr. Chairman, my impression in the Executive Branch in terms of the support given the notion of the FCCSET sorts of relations is that the Executive Branch has an opportunity to do a lot more coordinated and integrated work than perhaps in times past, in which the agencies are much more closely linked in areas of common concern. And that is, we are not trying to reorganize the Executive Branch but we are trying to reintegrate those organizations so that the whole indeed can be greater than the sum of the parts.

CREATION OF NEW JOBS

Mr. STOKES. You have mentioned, Dr. Gibbons, trying to get back to the 50–50 type of approach, the defense and our domestic situation. It has been mentioned by some that the peace dividend, for instance, would free up monies that could, for example, be used for NASA programs, particularly because many of the same aerospace companies would move jobs from DOD to NASA projects.

But I gather from what you are saying that you perhaps feel that this does not really get at the problem, which is for us to create new jobs globally rather than shift jobs from one Federal project to another.

Could you expand on that for us, give us some feel for where we are?

Mr. GIBBONS. I would be happy to do so. I think that is a very important observation. In other words, if we think about the economy and this extraordinary momentum of debt that we have gotten ourselves into, a debt rolling in each year, it is clear that we have to make a concerted effort on cutting down our deficit. The Congress and the administration are both working very hard at that.

It is a bipartisan issue and one in which I would hope that we can see some real progress over these next several years. That means that everything gets squeezed because we want to do as many things as we can, but we also don't want to do it at the cost of increasing the Federal debt and the load on our children.

In this sense, then, as we convert from defense and resources, as it were, are freed up, if we still have the same overall budget, there is a question of, what should happen to those resources?

It seems to me there are two big things that can happen. One is they can be shifted over into a more productive sector of the economy, that is the civil side, or they can be used to reduce debt or the deficit. But I don't think it is very effective to say if we move resources out of defense and into some other government program that somehow that is helping things. It might be seen to be better than nothing at all, but, for instance, to move from a pure defense-related thing over to, say, another major NASA project, we are still spending public dollars on public activities and we are not really transferring things out of government and into a private sector economy.

Obviously some of those things should be considered, but it seems to me they should have a much lower priority on our scale of successful conversions than moving out of defense and in some way having that end up being a private sector activity that is generating jobs and services in the civil sector that are fully competitive with our international competitors.

SPACE STATION

Mr. STOKES. Let me turn to space station for a few minutes. Last year my predecessor, Bob Traxler, former Chairman of this committee, when this bill went to the Floor offered an amendment at that time to cut space station funding from the requested $2.250 billion down to $1 billion.

I want to quote from Bob's statement on the Floor at that time. He said:

> The problem is that we cannot afford it. People are going to tell us on the Floor today that station would not damage other programs, and they are dead wrong. The fact is we cannot fund the space station at $2 or $2.2 billion without seriously damaging other programs in NASA and in this bill.

Then he said that, "The bottom line is we do not have enough money. We cannot afford $30 million to build a space station, and, over 30 years, $100 billion to operate it."

Now, I would take it that you would agree with those comments. We read Space News a few days ago and the interview you had there, and it seems that in some of the views you expressed there that you come in pretty close to that same type of philosphy.

Mr. GIBBONS. Someone said, "Always tell the truth; that way you won't have to remember what it was you said." I enjoyed that interview, I must say. I haven't read the article yet, but I presume they accurately portrayed the position I took.

Mr. STOKES. We can tell you what you said. We can tell you what they said you said.

Mr. GIBBONS. Let me see if I can recall the main points I would want to make on that, because the points I would make are not just my own, they came out of a dialogue with my colleagues in several of the White House offices and ultimately in the session with the President and the Vice President on this matter.

The problem, as you know, is with the squeeze on resources. The places you have to look the most carefully at are the places which in their outyears are projecting budget increases extraordinarily out of line with an increase, say, in our GNP. And if you look at the space station outyear budget for projected needs and the history of overruns, it is in our view, an ominous sign. Even with an umbrella of increasing resources to NASA over the outyears at a modest amount, the space station as projected would simply be a little bit like Pac Man and eat the rest of the NASA programs, including the technology package, which includes aeronautics, other space science, and other technology developments in NASA.

So the question was, is it possible to increase NASA's budget in a manner that would enable them to keep on track with the Space

Station Freedom and still do these other important things, especially the aeronautics part? And that was felt not to be plausible.

REDESIGNING THE SPACE STATION

So the question is, what do we do next? And the idea came up from some people who have had a lot of experience in this business that it should be possible to retain most of the important science and technology challenges in that station, but at a substantially different outyear cost, albeit about the same current cost. And as you know, I think there are $2.3 billion for the station plus the technology package in the 1994 budget.

So the challenge then was raised to NASA to see if they couldn't yet one more time go back and look at the station, and I know everybody is tired of going back and looking, but if it isn't working and it is not going to work, I don't see any alternative to going back and looking at it. Between now and early June, NASA is asked to provide the nation with options, not just a single option, which is traditionally what we have gotten from NASA, but several options that would tell us how much we would get of what sorts of capabilities, for what sorts of money, given a fixed amount of time. At the same time, we want to preserve what we consider to be a very important additional feature; that is that we continue on a good relationship with our international partners.

You can't do big science in an international context if you walk away from deals all the time. So we placed a good deal of importance on preserving the relations with our international partners in trying to carry this out and effect a revised plan.

I am encouraged by some of the early returns we get about what can be done by downscaling the outyear costs. It appears we can get many, if not most, of the functions that were laid out for Freedom and satisfy our international partners.

We organized a study within NASA. We also wanted an independent body to consider the redesign, and I think this committee has taken that same position. Dr. Charles Vest, the President of MIT, has just accepted the responsibility to chair a committee that will meet several times to give NASA and the White House and Congress their independent judgment about the process of that redesign study and its implications.

Although we don't have a lot of time between now and June, we should be able to get a much better picture of what our options are in terms of a station that is, albeit smaller, designed to try to carry out as many of the functions as we can, to preserve our relationship with our international partners, and to incur outyear costs more in alignment with NASA's overall budget increase. Then we will have the wedge that enables the technology initiatives such as aeronautics and other very important NASA activities to take place and grow in the outyears.

That is our hope, Mr. Chairman. Whether or not it works depends a lot on what happens between now and June.

COMMITTEE'S OVERSIGHT OF SPACE STATION

Mr. STOKES. Sure.

I know, Dr. Gibbons, that you are aware of some of the history of this committee's role in the station program, but I want to take just a moment to go back just a little bit for the purposes of the record.

Basically it was the committee's view from the outset that NASA should start with a much more modest concept—based on a "buy it by the yard" approach. We took that view because we felt in 1984 and 1985 that the budget crisis would only get worse, and ultimately we wouldn't be able to fund the station that NASA proposed.

It would seem now that there is no concern. It has sort of stood the test of time, and in fact even the station has been descoped three or four times and delayed three or four years as still unaffordable, especially if we want to free up money for other important technology programs.

The important thing at this point is not whether the committee was right or wrong. The question is, what do we do at this point in time in the nation's history?

And I take it that what you are proposing is roughly about $2.3 billion under the station umbrella with $500 million of that set-aside for new technology for us and $1.8 billion available for some combination of station transition development.

I guess the question that we would like to ask you at this time is, what type of rough numbers are you giving the redesign team to work with in trying to cobble together a substantially cheaper station?

Are we talking about roughly a billion, $1.2 billion? Can you give us some indication?

Mr. GIBBONS. We are trying to work out a range of numbers that will be helpful to the design team and to the review team. Those numbers are still being bandied around between OMB and ourselves and others, so I can't give you a firm set of numbers yet.

I would hope that we can provide numbers within a matter of weeks, Mr. Chairman. What we are trying to do is to give this group a plausible range of funds and then ask what could they do at significantly less than that number, around that number, and significantly above that number. The limits of the range are considerably less than $2 billion a year.

The exact numbers I have to defer on until we get them worked out with OMB. I would be happy to get those numbers to you just as quickly as we can.

Mr. STOKES. Realizing that team if they are to bring in a recommendation has to have some type of ball park figure to work around.

Mr. GIBBONS. That is correct.

ECONOMIC PARAMETERS OF THE REDESIGN

Mr. STOKES. But what you are saying is right now there is no such figure for them to work with?

Mr. GIBBONS. There has been no official communication from the White House to NASA on exactly what sort of numbers they ought to use for the straw-man figure.

NASA has proposed a set. We have looked at it, and rather than having a constant number, we have been talking about what should be a peak level of funding in the next year or two, and it is a tricky sum to come to. I understand the importance of giving the number because if you don't have the number, then you don't know what to design to. But there are a lot of things they are able to do until we get to that point, which could be as soon as the end of this week, in defining that range.

I did have a conversation with Mr. Goldin this morning who was pointing out to me some things that are already happening as they wrestle with this. There are some very creative ideas coming out of that group already in terms of opportunities to save a lot of money and at the same time sacrifice very little in terms of performance.

Mr. STOKES. As an old trial lawyer, let me just try one more time to see if we can get this, if we can't push it to the wall a little bit.

Are we talking substantially less than $2 billion when we are talking about a figure here?

Mr. GIBBONS. What we want to explore is something substantially less than two on one end but close to two on the upper end. We want to discover the sensitivity function—to find out what happens if you add this or take away that. We never really got that kind of analysis before.

Incidentally, I must say to the committee that the history of this committee in wrestling with these issues has been most laudable. It has been very helpful to me as I tried to learn something about the business.

SPACE STATION REQUIREMENTS

Mr. STOKES. I am going to ask one more question and then I am going to yield to Mr. Lewis after that.

Although the House and Senate Appropriations Committee disagreed over the last two years on whether we should proceed with the existing station, there has been and there is no agreement on station minimum requirements and priorities. So in reviewing whatever you propose, we will be looking at several things.

A, does the new design have adequate power and volume that make it sufficiently more capable on a cost-efficient basis, say, than Space Lab?

Is the microgravity science and materials and biotech given a priority role over human physiology experiments that are a precursor to the Moon–Mars missions?

And C, is it contained within a reasonable budget profile?

Could we get some comment from you on those three areas?

Mr. GIBBONS. I will be happy to, Mr. Chairman.

POWER AND VOLUME

Power and volume are very important issues, you are right, because they determine your opportunity space.

Some evidence is emerging that a lot of power requirements are, if not superfluous, at least not needed for the science part of the mission. Perhaps a more careful look at the use of power and its availability will enable us to cut back significantly on power without a loss of mission capability.

They are also looking at a range of, as it were, volumes in these three or four options that we have asked NASA to develop.

SCIENCE PRIORITIES

Third, microgravity and biotechnology are the key elements of the scientific justification for the space station, though they cannot carry the full justification. The notion of this as the stepping stone to a manned trip to Mars and other solar system exploration is, and I will argue this forcefully, something we might want to leave to our children and grandchildren. That is something we don't have to be chasing quite so hard at this time in this decade. It is a long-term search for mankind, perhaps, and that should not be a driver in terms of costs.

In other words, if it costs a lot more to maintain the long human duration in space, then we ought to think again about that as a requirement.

There are other ideas, too, as you know. There are already conversations among our international partners about changing the orbit of this station so that we could get to a higher inclination, which would permit us to interact with the Mir, the Russian long-duration station. And there are data and experiences that the Russians have on long-duration human flight that may well give us a leg up in our knowledge of long-duration human flight.

Mr. STOKES. Thank you, Doctor.

Mr. Lewis.

BUDGET PROFILE

Mr. GIBBONS. You also asked about the budget and budget profile. We want to look very hard at that—and we have worked with Mr. Goldin on this—in terms of how well he can nail down contracts so costs don't escalate on NASA. When people enter into contracts they should not expect to use it as a means to get work started and then change the contract. We need to specify what we want, put some teeth in it, and monitor contracts so we are not overtaken by overruns.

And we have to look at the outyears. It is silly to go on a year-by-year basis on a decade-long project. We have got to keep these outyears in mind.

Mr. STOKES. We just had a hearing last week with Mr. Goldin and his managers with reference to some of those contract costs, and to his credit, he is proposing some initiatives that made a lot of sense to us in terms of some of the contracts they granted, and subsequently you come back and put the specifications in the contract that you knew couldn't be done at the price that was entered into, and so forth and so on. So that is a major concern to this committee.

Mr. GIBBONS. Well, I share that concern and I have been pleased also to see that apparently this is understood and appreciated by NASA management.

Mr. STOKES. Okay.

Mr. GIBBONS. We will have to see how it works out, but I think the sounds are right.

Mr. STOKES. Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman.

Nice to be with you.

Mr. GIBBONS. Thank you, sir.

QUESTIONS FROM MR. LEWIS

Mr. LEWIS. Director Gibbons is an interesting title with an interesting ring to it. I have not been terribly excited about some of the appointments made by our new President, but your appointment in this government is a very important step. I look forward to working with you, Jack. It has been a pleasure up to now and it will be in the future.

Mr. GIBBONS. Thank you. I deeply appreciate that from someone who has had a chance to find out a number of my faults.

Mr. LEWIS. In preparing for this meeting, I was reminded of a very interesting drive that everybody really should take who is concerned about our environment and our use of our resources and the need to be willing to rethink where we have been. You drive from our home in Redlands towards Palm Springs, and it is about 60 miles away.

In the days when we were very concerned about crude oil and the problems that some of those uses have had upon our environment, some of the dreamers were talking about a different kind of energy, namely wind energy. I thought that might be a way of supplementing the energy available in Southern California.

Now, the mountains as you enter Palm Springs are blanketed with windmills. It is an incredible blight upon the environment and it produces such a fractional piece of energy.

The Chairman has been very helpful to me personally by taking the time to go to stations' centers to try to get a different sort of understanding of that technology.

One of the things that has impressed me the most as we have redesigned station several times is whether NASA has rethought what size staff was necessary to carry out the functions that they were given responsibility for.

I would hope as the President's science adviser that you would help this committee and NASA to do that. Perhaps that billion or billion and a half or otherwise within reasonable budget limits can accomplish much of that.

Mr. GIBBONS. I think your point is very well taken. You can't cut down on the cost of something without having it show up in operations. I think we are seeing this now in the case of military, in the base closings and reduction of forces in Europe. And one should expect to see some of this in terms of NASA's investments and resources in the station.

If NASA's overall budget is on a level or on a slightly increasing ramp, then what one will see is not necessarily reduction in their overall strength, but as their station resources are reduced, then you ought to be able to see resources appear in other compelling activities such as aeronautics, space science, environments.

Mr. LEWIS. Right.

Mr. GIBBONS. But you are right, you simply can't hold on to people and reduce costs.

PUBLIC ROMANCE WITH SPACE

Mr. LEWIS. Speaking of station and NASA, this committee needs to rethink where we have been with some of those programs rather carefully. The best and healthiest review we get is when our mark sees the light of day out on the House floor. The kind of commitment that the Floor reflects is the public view of NASA's future. And there is no doubt that the American public has some special romance with this thing called space and they want to see us play a role there.

So as we go forward and rethink, I hope you would help this committee keep in as close as touch as possible with not just the country and the people out there, but their Representatives on the Floor as well.

Mr. GIBBONS. It is a fair point. I think we have a true joint mission here to try to make sure that people understand what we are doing and why we are doing it. Not that we are backing off on technology but that we are redirecting technology to what is perceived to be the most beneficial way to get to the national goals that have been espoused.

Mr. LEWIS. Dr. Gibbons, I have suggested to you privately but I think it is important for the record that as the President's science adviser, your job involves making certain that the administration has focus at the highest level on the importance of science within our national budget.

In this subcommittee, in classic form, you have very popular people programs, many of them automatic in expenditure—housing, veterans, and EPA. It would be quite easy to presume that if we cut back significantly in scientific expenditure—and specifically I am thinking of our expenditure in space—that the money would automatically then go to help reduce the deficit. In classic nature, that is not the way Congress works. I really urge you to keep that in mind as you recommend adjustments as well as cuts.

Mr. GIBBONS. Thank you, Mr. Lewis.

I agree with you about that and I also agree that we need to keep a close eye on the support of science itself. I think the American people agree with us and with the President that science and technology do provide an opportunity for us to develop new options for ourselves, our security, our environment, our job futures, and that this doesn't come without investment. And the investment in research is going to be a very important part of it.

I was pleased, for instance, to see the fiscal year 1993 supplemental for the NSF increased, as it were, to keep it from going into a dip, and I think the administration understands that that has some near-term effects of employing graduate students and buying lab equipment and the like, but it is also very much a long-term investment strategy. It is not simply a stimulus.

I think it will be interesting and important for us to work together on the long-term science budgets for this country, and we intend to spend a lot of time and thinking about that as we prepare for the fiscal year 1995 submission to your committee.

ACCESS TO INTELLIGENCE RESOURCES

Mr. LEWIS. Very good. I can't help but be interested in those aspects of your job that now involve the space council. The council was itself involved in a major discussion of the commercialization of space.

Among my other jobs around here, I serve also on the Defense Subcommittee, and on the Intelligence Committee

I certainly hope that the science adviser and his team have access to those intelligence resources which will help better advise the President.

Mr. **Gibbons**. I am pleased to report that my conversations both with Secretary of Defense and with Jim Woolsey, the Director of the CIA, have been very fruitful in that sense. They are both concerned and interested in the relevance of many of their technologies and capabilities to things that, in a broad sense, might be called dual-use or spin-out.

There are a number of archives, for instance, in the intelligence community of indicators of what is going on down on earth that could give the environmental community a great deal of help, and there will be a major study of that this summer. It will be a classified study in order to ensure protection of the information. But at the end, presumably, there will be some releases which could give us a lot of help in areas that otherwise would call for additional resources.

So what we hope to do is mine those resources, and I am very pleased that the Directors of both those agencies are very much in favor of doing this.

PRIVATIZATION OF LANDSAT

Mr. **Lewis**. Just a couple more questions and then I will yield back.

I saw an interview of yours recently in which you were constructively critical of LANDSAT's attempt to privatize 95 percent of what is the public market.

Mr. **Gibbons**. I had forgotten I said that.

Mr. **Lewis**. Do you have a view on what we can learn from the LANDSAT experience?

Mr. **Gibbons**. What we have learned is that a lot of uses, at least to this point, of those kind of data are in fact public uses. While there are some private uses, the majority of the customers are in the public sector and that likely will not change substantially over time. There are very clear reasons for the present strong support of the defense community and NASA in LANDSAT. For instance, it was a great deal of help during the Desert Storm operation.

It is a shared resource. That is bound to mean savings if we can do it right.

The hope for total privatization of LANDSAT I think is still something we should keep an eye on, but one should examine the extent to which we can save money to do it. To privatize simply for the sake of privatizing, if it costs us more to go that way, would not be a necessary or smart thing to do.

I would have to say I am agnostic about the extent we can privatize that operation. I would hope that we can find a constantly increasing commercial sector interest in these data and non-Federal Government such as State and localities. You know, a lot of cities and counties and States are now using LANDSAT, so that is a quasi-commercial utilization.

How is it going to be dominated by public needs? It seems to me the best play in the immediate future is to to be sure that we combine our defense and our civil interests in this so we no longer have separately operating systems but can combine them.

COMMERCIAL SPACE LAUNCHES

Mr. LEWIS. Can you give us some preliminary indication as to whether you will be supportive of continuing Federal efforts to incentivize the commercial space launch effort?

Mr. GIBBONS. There is a lot of controversy about how far, for instance, the U.S. should go in making agreements with Russia—so that they could commercialize some of their space capabilities as space launch capabilities—or the Chinese and others that we are trying to coax into a market system. In doing that coaxing, we are simply inviting competition for our own people in commercial launching.

That is still a major question before the Congress and the President, and I can't predict how it is going to be resolved. However, it seems to me if we are trying to coax these folks into the market system, then we ought to let them play in the market system.

In terms of our in coaxing, I believe it is important to draw private interests into this business. If we do get them interested enough, then they are going to bring the innovativeness of the marketplace to the business and hopefully provide us with ways of getting lower costs and more services. I think it ought to be examined and evaluated as we go along in time.

You mentioned windmills awhile ago. Major subsidies of windmills drew that technology to the point now where it is essentially competitive. In other situations, once a few tax breaks were dropped, the industry was wiped out. We have to be careful about the extent to which we subsidize and then pull the rug out from under investors.

Mr. LEWIS. Jack, I look forward to working with you. I appreciate your response.

Mr. GIBBONS. Thank you.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. STOKES. Thank you.

Mr. Mollohan.

QUESTIONS FROM MR. MOLLOHAN

Mr. MOLLOHAN. Thank you, Mr. Chairman.

Doctor Gibbons, I would like to welcome you along with the other Members of the committee.

Mr. GIBBONS. Thank you.

Mr. MOLLOHAN. I would first like to note, Mr. Chairman, I think it was about 18 months ago that in an interview back home I used the word "incentivize", and I had a college English professor, my wife, and about three people in my office contact me and say, "Where did you get that word? I don't think there is such a word". It turns out, we tried to look it up in the dictionary and it wasn't there.

So I am really in awfully good company that the Chair used it. Dr. Gibbons used it. I think it is a great word.

Mr. GIBBONS. As our predecessor Ben Johnson said, "Language is a dynamic process." I also remind you that President Andrew Jackson, who was a terrible speller, once said that he had no respect for a person that couldn't spell the word more than one way.

Mr. STOKES. That is pretty good.

Mr. MOLLOHAN. I can remember a time when I would have liked to have known it.

Doctor, there is an awful lot of knowledgeable people who express concern that space station cannot be significantly downsized again and reduced in capability and still remain worth doing. We have gone through the exercise once or twice before.

In other words, if you go through yet another downsizing, the quality of station is just too compromised and you really won't be able to perform missions on station, that could not be done, really, truly, some cheaper way. This makes an awfully good argument for those who say, "Well, there are cheaper ways to do it. We don't need a station."

Obviously—well not obviously—I am not speaking for you, but I take it you disagree with that. And I just would like to hear you comment on this issue.

Mr. GIBBONS. The first time I looked seriously at space station was around 1983 when I was directing the Office of Technology Assessment. We did a major study on alternative ways to build a space infrastructure, space station being a part of that infrastructure. Our first observation was that the design should be driven by the goals and mission statements that you wanted to achieve.

One of our problems is, we have been shooting at a moving target. We can't build this thing just to see what happens. There is too much money on the table. That is fine for little science. If it is a small package, you can explore all you want, but when it gets to this size of technology, that is no longer a sufficient rationale.

So one of the first questions you have to address is what makes it worthwhile to make this a major investment. I think the study that is going on now will perhaps give the most serious response to the question you raised: Are there fundamentally important, high priority capabilities of Freedom that are so close to the edge that if you cut down on the size of that station, significantly, you are going to lose them?

What do we lose, as it were, in backing this thing down to a manageable budget or deferring perhaps some of those experiments until later?

I have yet to encounter what to me are compelling reasons for the larger size that sophistication and other cleverness can't provide in a lesser environment.

I can suggest one thing. I predict we will find that the power requirements can be substantially downsized with very little sacrifice in mission capability. That is my guess. I am sort of holding my breath until we get to early June on that question.

SPACE STATION POWER REDUCTION ACCEPTABLE?

Mr. MOLLOHAN. Okay. Are you able to say that you make the observation that a power reduction is acceptable because you downplay the necessity of long-term manned occupancy of the station?

Mr. Gibbons. In part because of long term occupancy, but in part because I think an imaginative look at the power requirements on board could save a substantial amount of that power with very little sacrifice in mission capability. I know there are some arguments about this for some of the packages, but I am talking about the overall station requirements.

Let me give you one small example that I just heard about today. In examining the capability on board for fire detection, it appears as though there may be some substantial possibilities for reducing the power requirements for that part of the system, which in turn would enable you to scale things down.

It is not Samuel Johnson's the "night before the hanging which doth focus the mind," but it is a short period in which to look very hard at some substantial changes. What really new innovative ideas can come out of such a sweatshop as is going on over these 90 days could well deliver us some very important new options, and I honestly think we should hold our breaths until we get to the 1st of June.

INSTRUCTIONS TO NASA

Mr. Mollohan. Okay. You alluded to this and I was going to talk about this a little bit. But I believe it was Dan Goldin in the hearing the week before last, in the form of an oversight hearing, who made the distinction between starting with the program by giving the agency a sum of money and saying, You have, for example, a billion dollars, go do science work. And so out of that, that is obviously—that creates its own efficiencies. I mean everybody is trying to get as much science out of a billion dollars or a program which might be more like station start with the capabilities, the requirements, if you will, and say, We need to do these sorts of things, try to do it as efficiently as possible.

And in this yet again redesign, which approach more fairly characterizes the instruction from the White House to NASA?

Mr. Gibbons. It is a fair question. It seems to me the best way to describe it is that our resources are not unlimited. We have spent time on this, there is momentum and financial investment.

We have to build on the past. We have to prioritize our mission objectives and tell the designers to come up with a variety of ways and schedules to accomplish them. Only then do we have a rational basis for choice. At the same time, there are not unlimited resources available for this. There are a set of mission objectives that one can prioritize in terms of importance as adjudged of one kind of science versus another. We must ask the team not to simply give us a single number, but tell us what a station looks like if we spend a certain amount of money, a certain amount less, or a certain amount more. Accordingly we will end up with a sensitivity analysis of what we get in a station for what we add in money.

So that is why I am so hopeful that this parametric analysis, you might call it, will enable us to get that sense. You remember the old Sears, Roebuck, "Good, better, and best" slogan. They gave us a sense of what you got in exchange for your money. In a sense, this is a similar approach.

Mr. MOLLOHAN. Did you start with any prioritization of mission objectives on your part?

Mr. GIBBONS. To some degree. We provided terms of reference, but we are not trying to run NASA out of the White House. That would be disastrous. But we did want NASA, too, to understand what we thought they ought to be thinking about.

We want them to consider our relations with our international partners. Their programs are very important and the redesign must pay close heed to this. For that reason, the international partners serve on the study group as well as on the advisory panel.

We want the best science to receive the most attention.

Third——

Mr. MOLLOHAN. What kind of science?

Mr. GIBBONS. Microgravity, biotechnology.

Mr. MOLLOHAN. Life sciences?

Mr. GIBBONS. Life sciences.

Mr. MOLLOHAN. In that order.

Mr. GIBBONS. We did not specify the order. I would rather hear it from them rather than trying to dictate that.

Mr. MOLLOHAN. Okay.

Mr. GIBBONS. We clearly discounted the idea that there would be a manned mission to Mars in the near future.

We encouraged them to attempt to use substantially fewer shuttle missions and substantially less extravehicular activity in the interests of safety, reliability, and cost.

NASA'S FLEXIBILITY IN THE REDESIGN

Mr. MOLLOHAN. In this next question I would like to understand at just really how much flexibility the Agency may feel it has to come back to you with an answer that they feel is the "right" answer, after their review. Space Station Freedom is currently at the critical design review—which is pretty far down the path, on a second redesign to be asked to go back and redesign yet again.

The redesign team is being asked to include the international partners and to have as much capability as possible. Is it possible for the NASA redesign team to come back and say, "well, we believe that there is a fourth alternative; should be considered the station in its current configuration substantially, with some savings here and there."

Are you prepared for that kind of an answer?

Mr. GIBBONS. I have talked with Mr. Goldin about capturing as much as possible from the present design to produce a recognizable descendant of the present Freedom design. That then gives you an envelope that you could extrapolate on back to Freedom if you want to.

But I don't know whether that is going to be one of the options they look at. I will know better within a couple of weeks. The first organizing meeting of the review panel is going to occur Saturday April 3. I would hope to be able to hear back from NASA within the next couple of weeks on what kinds of options they are trying to explore.

We have not tried to push them to tell us that kind of information. I read Space News, too, and I see those three conceptual designs there; they may or may not reflect what NASA is doing. And I do know that Mr. Goldin has talked about probably four options instead of three. My guess is if that is the case, he would try to see what would happen if you move more in the direction of something that looks like a derivative of space station.

Mr. MOLLOHAN. You certainly sound like you are moving towards considering that option.

Mr. GIBBONS. Absolutely.

MANAGEMENT AT NASA

Mr. MOLLOHAN. You asked about the Pac Man metaphor here a minute ago, I believe, talking about the station eating up somebody's budget—I guess NASA's—into the future. Do you have any sense about whether that Pac Man phenomenon is more management or just too much—more a management problem, efficiencies that could be addressed—inefficiency, that is, could be addressed by better management, or just simply too much program out there, too much mission capability?

Mr. GIBBONS. There is an analogy I hadn't thought until you raised that question. The President said the other day, regardless of how well we do on the investment package, our deficit reduction strategy and all of rest of all the things we have done so far, if we don't really begin to tackle the health care issue, the rest really is just not going to work.

And it seems to me the same on the station. When we talk about a station redesign, integral to that is a redesign of the way NASA does its own business, organizes, and carries out its own work. There are enormous needs, as well as opportunities, that I know are being pursued.

We were pleased, for instance, at the appointment of Jack Daily, General Jack Daily, as acting deputy at NASA. It is another sign that they are going to be working on their own internal structure, on how they are going to do things, administering their work setting, on contracts, on persons their work in addition to the hardware technology types of things, I think they have to work very hard in both of those arenas, and I think there are major cost saving opportunities in those areas.

Mr. MOLLOHAN. You used the word "enormous." Would you apply that to station, do you think there are enormous amounts to be saved in changing management?

Mr. GIBBONS. "Enormous" is a very qualified—

Mr. MOLLOHAN. Maybe I am quoting you unfairly.

Mr. GIBBONS. I believe the evidence shows that NASA's management resulted in a number of substantial misestimates of costs and a lack of cost control. Poor management cost them a lot of their currency and has in no small part caused this latest review.

Mr. MOLLOHAN. I would love to ask you if you could quantify how much could be saved out of station program through management efficiencies.

Mr. GIBBONS. If you ask in June, I will try to tell you.

Mr. MOLLOHAN. Thank you.

Mr. STOKES. Mr. Thornton.

QUESTIONS FROM MR. THORNTON

Mr. THORNTON. Mr. Chairman, I beg your indulgence to share with my good friend Jack Gibbons an anecdote which I think makes a point.

Jack, after becoming president of the university, I hired Jim Purdue, who had been academic vice chancellor of the SUNY system in New York to help us establish a strategic plan for the university. He was intrigued with some of the things that we had in Arkansas, like Deer Day where we let out for the first day of deer season.

He told me about the three moose hunters from upstate New York who chartered a plane and went up in Canada hunting moose. The pilot said, you guys have to realize this is a balanced plane; we can only get out of here with four of us and one trophy.

They all came back dragging a trophy, and one of them said, look, last year we paid you $200 apiece and you let us put them all in the airplane. He said, well, this year it is going to be $500 apiece.

They groused but paid, loaded the trophies in the plane, went down the runway lifted off, clipped a hedgerow at the end and pirouetted into a marsh on the other side upside down.

One of the hunters shook his head groggily and said, where are we? And the other said, about a hundred yards from where we crashed last year.

Mr. THORNTON. Jack, Francis—you quoted Andrew Jackson and Ben Johnson. Let me throw a Francis Bacon at you and Nova Morgana. He wrote it would be unsound and contradictory to suppose that that which has never been accomplished can be accomplished except by means which have not yet been tried.

Mr. GIBBONS. Well said.

Mr. THORNTON. It is not enough to put more dollars into a program. It is awfully good to rethink what we are setting out to do and to take a fresh approach, which is what I hear the Chairman, Mr. Mollohan, and others saying, that it is high time we do with regard to this station.

Now, I personally don't want to see it ended. I want to see man's space effort continue with human involvement in the space environment, but I would like to see the results of the kind of study that you are bringing forward and to see whether or not there may be some new way of achieving the goals which we are going to be identifying; and I commend you so much for the approach you are taking.

Mr. GIBBONS. Thank you.

SCIENCE AND TECHNOLOGY POLICY

Mr. THORNTON. Yet I would like to say that that is a small problem compared with the problem that is central to your management of the science and technology policy agency because it is more than science; it is a technology policy. It is, how do we get the biggest bang for the buck out of our Federal laboratories? How do we utilize the great capacities of science to harness the inventive genius of the American inventor to the marketplace? How do we spring from the knowledge that we accumulate in our universities into partnerships with business, the private sector and public sector at all levels, in order to strengthen America's economy?

Do you agree that that is a vitally important part of your responsibility as the Director of this agency?

Mr. GIBBONS. Absolutely and fundamentally, and I appreciate you bringing that to the attention of today's hearing.

We feel that there are enormous opportunities to capture. You mentioned the repository of knowledge of technology and science that is contained within the Federal system, for example, within the national laboratories. For some reasons, perhaps lack of a sense of what is important or what is opportune, we have not made it easy for interactions to occur between these labs and people in the private sector who would like to have some help with their problems or make opportunities for co-venturing in advanced technology areas.

I just learned last night of a very interesting cooperative venture between an advanced ceramics company and one of the national laboratories and one of the defense installations of the Department of Energy. It involves development of some very advanced methods in ceramics production. It requires knowledge of fundamental physical chemistry and solid state, as well as knowledge of manufacturing and quality control. In other words, it requires a combination of public and private sector expertise. The private sector people are putting in at least half of the money, so it seems to me a good example of the new opportunities we have to bridge past gulfs between Federal activities on the one hand and private sector activities on the other.

Now, we understand that agency missions can, in fact, be sustained while encouraging a lot of productive interaction with the private sector. This orientation toward an easier flow of ideas and information from universities, industries, national labs, and the Federal sector, as well as among the Federal agencies themselves, creates an enormous set of opportunities.

Mr. THORNTON. Opening the system up, I submit, may be more difficult than resizing the space station.

Mr. GIBBONS. Yes, sir.

GOVERNMENT ASSISTING INDUSTRY

Mr. THORNTON. It is a challenging jump. There are agency capabilities that are not well known outside of the agency. I have an illustration, because while it is not in my congressional district, Mr. Chairman, it is near enough that I am familiar with it. The National Center for Toxicological Research located between Pine Bluff and Little Rock, Arkansas, is a great facility which the Food and Drug Administration manages, which has the capability for enormous improvements in food safety and in analytical determination of issues relating to regulatory science, and also moving from regulations into how do we use our knowledge to enhance our commercial application of discoveries here at home.

Is there a way for a regulatory function to also assist not in undercutting those regulatory requirements, but assisting American companies to make safe drugs, foods, other supplies here at home, rather than have the discovery shipped overseas and bring back the products?

Mr. GIBBONS. Precisely. That is an excellent example, it seems to me, of the many opportunities that are there. It is going to take a new mood to be able to help these folks understand those opportunities and feel encouraged rather than discouraged about pursuing them.

Mr. THORNTON. I am very pleased that Dr. Kessler is well aware of this and is moving in this direction, but I think it is going to take someone in your position to really pull together this information and to find a way of making it available to entrepreneurs and other people throughout the country.

I know you have outlined wonderful ideas here, but I think the challenge of doing that is the most exciting thing that you have facing you.

Mr. GIBBONS. Thank you, sir. I appreciate your vote of confidence and also the realism that you express that this won't happen automatically. It is a cultural revolution that we are talking about, and I think with the Congress and the administration agreeing not only in principle but in detail, we will have a real chance to do something these next few years.

Mr. THORNTON. There are some people who fuss about this, saying it is industrial policy, that we don't want to pick winners and losers and that—as though there were something wrong with applying our intellect to the marketplace.

I would like to quote a statement in that regard to you; it is, The modern achievements of skill, enterprise and science, new ideas with germs of power, must be recognized and diligently studied as they have brought and will continue to bring daily competition which must be met. If the world moves at 10 knots an hour, those whose speed is but six will be left in the lurch.

You know that could be said today, couldn't it?

Mr. GIBBONS. Who was it?

Mr. THORNTON. Justin Smith Moral at the time that he introduced the concept of land grant universities in the Congress of the United States 130 years ago.

Mr. GIBBONS. A hundred and thirty years ago.

Mr. THORNTON. Developing an industrial policy for agriculture, for using the discoveries to make it possible for America to compete, and it seems to me that a 130-year-old idea which has worked so well in agriculture might well become the focus of an effort to use our knowledge to make our economic competitiveness much enhanced.

Mr. GIBBONS. I agree with you and that is a wonderful quote. It shows and reminds one again how one can get tied up in semantics. In fact, we have—we have a number of examples, programs—agriculture being the best—of the long-term partnership between the public and private sector in this place we call the United States. It goes from agriculture to aviation, to electronics, to a wide variety of winners. It seems to me it is true the government shouldn't be investing in one particular firm or another, but that is not what we are talking about.

Mr. THORNTON. That is right. We are talking about elevating the capability, right?

Mr. GIBBONS. Exactly.

Mr. THORNTON. Well, I know you looked with great pleasure as I searched in my billfold for that quotation. You thought I was going to bring some money out and offer it to help your activities.

Mr. GIBBONS. We would appreciate all the help we can get.

Mr. THORNTON. I think that both you and I agree that ideas and working diligently to implement those ideas may be the most important thing that any of us in this room can do.

Mr. GIBBONS. It is the ultimate currency.

Mr. THORNTON. Thank you, Mr. Chairman. I yield back.

CONTROLLING NASA COST OVERRUNS

Mr. STOKES. All right. As we come back to the budget, Doctor, I just might offer a word of caution in terms of the options that are going to be brought to you for review.

The committee is going to try very seriously to have the type of oversight review we had this past week where we looked into six different areas where there have been significant cost overruns. It started out with an area where contractors said they could build two toilets for space that cost $8 million and wound up building one for $24 million, and the last question I posed to the NASA official was, had this contractor ever built a toilet before? And he had not.

So we are going to be looking at this whole situation very carefully. We hope that you are going to look at these options very carefully.

Mr. GIBBONS. Yes, sir.

Mr. STOKES. Another one of the areas that we looked at, there was a cost overrun just two months ago of somewhere between $500 million and a billion dollars, and that was on station?

Mr. GIBBONS. Yes.

Mr. STOKES. And so we just want you to be careful about the figures and the credibility of the contractors, as in NASA people with the options being brought in. And then, of course, another concern is our 602(b) allocation which, as you know, depends upon—what we can do, it depends on that 602(b) allocation; and we would like you to keep it in mind that after you craft a NASA budget, details of the total of $15.3 billion, if our allocation—602(b) allocation is not a healthy allocation, we may not be able to deliver the $15.3 billion NASA requests.

And so we want you to have that in mind also when you submit your request to us.

Mr. GIBBONS. Thank you, sir. I will indeed.

BIG SCIENCE VERSUS LITTLE SCIENCE

Mr. STOKES. Now, Doctor, our committee has been increasingly concerned with the problem of big science squeezing out small science. We made that point over and over to the Foundation in connection with programs such as LIGO and the eight-meter telescopes.

Our concerns have been a relatively tough sell. I reminded Dr. Massey on Friday of this past week that we had warned that projects like LIGO, even if NSF's budget remained at level funding, would take on a political life, would be virtually impossible to cut, eliminate or down-scale; and of course, he responded to us that that is exactly what had taken place, LIGO had taken on a political life.

And I guess, in a way, the LIGO example is a station problem in miniature. LIGO was first proposed with a total cost of the $197 million and now, with delays caused partially by our inability to fund it, LIGO has risen to $250 million; and because it has taken on a political life, it would tend to capture the first dollar appropriated to NSF, regardless of whether we deliver a 18 percent increase or a zero percent increase. And, of course, with zero percent increase, with LIGO having the highest priority, would leave no money for the small investigations.

I wonder if you would comment on that for us. What is your view?

Mr. Gibbons. I share the committee's concern that many areas of science are leading us toward increasingly expensive enterprises.

The same in technology. If you think about an advanced commercial supersonic airplane or fusion research or many of these other areas, the very nature of the work carries one to a size, a scale that almost embodies a voice telling you, you need to do this as an international venture.

The problem is that voice only speaks, all too frequently, after we have already committed to a project as a national venture. Then you are in trouble. And we know that to be the case in the superconducting supercollider and in the case of space station. When people come up with large experiments, we should ask them before they start, can't you devise an international consortium and do this work as part of a multinational if not international venture?

There will be resistance. They say it makes it more complicated and the likes. But it seems to me the universal language of science gives the science and technology community probably a better chance than most of the other parts of our societies to learn how to develop long-term relationships with other nations. And it seems to me that gives these projects a value that even transcends the money involved.

We are learning how to live and work together on things, so I would hope as we go toward the future that every big project from the very earliest outset would be couched in international terms and that we would move away from that only if there are compelling reasons for doing so.

The fact is that in LIGO, for example, we are already committed to all of the infrastructure of that experiment being in the lower 48 States. That makes it much less interesting, say, to the Australians or the Europeans or others, and lessens the extent they can be drawn in and made part of an international venture.

It is not as though every nation must have a piece of every experiment, but we are going to have to move some of these investments around the world. If we do this experiment here and you folks help us, then we will do the next one over at your place and we will help you. That is a tougher job to do politically, but it seems to me the earlier you start on it, the easier it is going to be.

We are concerned, Mr. Chairman, that these very large "big science projects" not be done at the expense of the individual investigators pursuing interesting ideas. That ought to be the last place that we look for resources to carry out these larger experiments because history shows that while many very important things come out of the work of teams, the most interesting ideas usually emerge from an individual investigator.

And those investigations are not all that expensive. It is the so-called "little science" that we need to learn how to build a better fence around.

Mr. MOLLOHAN. Mr. Chairman, I hesitate to ask the Chairman to yield, but I would like to follow up on that.

Mr. STOKES. I yield to you, sure.

INTERNATIONAL CORPORATION IN SCIENCE

Mr. MOLLOHAN. Thank you, Mr. Chairman.

I interrupted because I feel that the international cooperation issue is one of the very best arguments for pursuing the space station along the current configuration. I would like to hear you talk about that a little bit.

During the floor debate last year on Space Station Freedom I chose to give my floor statement on the International participation in Space Station Freedom, because I thought it was one of the most compelling reasons to continue the program. As we do undertake an increasing number of big science projects, particularly in the post-cold-war era, it seems to me the real solution is international cooperation; in teaming relationships and in dividing up the projects and making sure they are all coordinated. We haven't necessarily been successful in regard to Space Station Freedom. We are pushing our international partners pretty hard.

I know that the International partners are a bit upset to put it mildly. Could you comment on the space station program and international cooperation in light of your answer to the previous answer to the Chairman?

Mr. GIBBONS. I will be happy to respond to you personally.

One reason I felt so strongly about working very hard to keep the station idea alive was that we had developed an international partnership. Sure, we were covering most of the costs, but these countries were involved with us. We had international treaties set. They had already expended money on their part of the project. I felt it would be a terrible thing to not give full weight to the fact that they were involved with us. Therefore, to me, that is one of the top priorities in terms of redesign and recommitment.

Now, we don't necessarily have to go off to Mars together to develop international relationships. We can do it with international development, with international health issues. There are a lot of areas to work on. But, in fact, one of the more important ones right now is that space station and those partners of ours. And I think that is well worth the currency to keep this thing moving in a way that is going to be meaningful.

I do feel that certain areas of science, particularly physics and astronomy, and certain technologies, such as very advanced energy ideas—fusion is a classic example—and some areas of health, are trending in the direction of requiring very large capital. And I think that trend tells us it is going to be increasingly important, not less important, that we learn how to develop these long-term relationships and carry them out. That is why a station in and of itself is probably less important than the notion of international ventures.

Mr. MOLLOHAN. Thank you, Doctor.

Thank you, Mr. Chairman.

Mr. STOKES. Sure.

U.S. MATHEMATICS AND SCIENCE EDUCATION

Dr. Gibbons, Dr. Bromley, your predecessor, transmitted to the President on January 4th of this year the 1993 biennial report on science and technology, in accordance with the National Science and Technology Policy Organization and Priorities Act of 1976.

On page 53 of this report, it contains some rather disturbing information on math and science education. Let me just quote from that report. It says: "In one recent study, both the top 1 percent and the top 10 percent of 9- and 13-year-old U.S. students scored near the bottom in mathematics and science when compared to similar cohorts in 20 other countries.

> In a previous study, U.S. students in advanced placement courses in their final year of high school scored near the bottom in chemistry, biology and physics when compared with students in 13 other countries. Another study found in mathematics, the best students in the United States performed only as well as the average students in Japan.

Dr. Walter Massey of the NSF commented last Friday that the poor performance of American school children derives from the huge variance in quality between the best and the worst schools in the country. The OST report seems to contradict Dr. Massey's observation.

Would you care to comment on why American children perform so poorly relative to the children of other countries?

Mr. GIBBONS. Well, I wish I had a simple response to that. First, I need to become more familiar with that situation, although we have studied it, as you know, some at OTA and at times past. It is very complex. The data are poor.

It is hard to compare apples and oranges in making these international comparisons. But despite all the excuses we might have, some of which are quite defensible, I think there is clear and compelling evidence that we are in trouble compared to the people with whom we'll be competing for jobs in the next century.

We are a nation with a lot of autonomous school systems and varied curricula. Some schools pay more attention to preparing kids for testing than others do. And we have an extraordinarily wide involvement of kids in school compared to other countries in the world. When you take all of these differences, it is really difficult to be exact—to make exact comparisons between the U.S. and elsewhere.

We do know that at the limits, at the very brightest student and the most handicapped of students, there is a kind of universality about where the top 10 percent and the bottom 10 percent are. But we also know as kids progress in school and as you go on into the secondary years, the evidence is ours don't track as well as some of these other countries.

You might argue that is because more kids are dropping out in those other countries compared to our own. Whatever the explanation, it is worth very careful analysis. This apparent discrepancy is well worth pursuing to see why it is we interpret these data differently.

And I intend to go back and look at the report Dr. Bromley submitted to President Bush and compare notes with the NSF. I will also talk with the people at OTA and see if we can't get a clearer explanation of what is going on.

But suffice it to say that while there are arguments about exactly how well we are doing, it is perfectly clear we are not doing all that well. And it is time that we put our resources, some innovative resources into this area. And that includes, Mr. Chairman, a lot of technology, a lot of the computer capabilities, both for improving our teachers' skills and the methods for delivering education in a more individualized way to kids so they can reach their full potential.

I think we have underemphasized the capability of technology to assist in the educational process and the fundamental Federal role involved in this. Surely, the States and localities are always going to be setting the curricula and providing the most financial support of the schools, but we have a common cause in developing methods to help teachers and kids reach their fullest potential. And it seems to me that the commitment you see in the President's budget reflects in hard dollars our willingness and eagerness to get on with this.

MINORITY EDUCATION

Mr. STOKES. In that same vein, I guess, I was reading through your budget justifications, you had mentioned preparing for the 21st Century, and in that respect, there is an item, a line there with reference to the fact that we need to do more in terms of minority education. I guess one of my concerns in that area when we think of the problems we have just discussed with reference to the general situation, and we think about the Hudson Institute and the other demographic information which tells us in the year 2000, one-third of the new work force—new entries in the work force will be minorities.

By the year 2020, 40 percent of the work force will be minority. We know already, for instance, that in 25 of the largest school systems in the country today already a majority are minority, and if we consider the high-tech type of a world we are talking about in the year 2000 and beyond, it would seem to me that we almost have a crisis that we are just not properly addressing in terms of preparation of these youths for the 21st Century.

Mr. GIBBONS. I agree with you. And I think not only is there a big challenge but I think a lot of very important opportunities are there also. I have been hearing recently about some fascinating things. In Silicon Valley, local computer companies have been working with the school systems to provide kids with a much more effective access to desktop computers, and also interesting software.

They have also been placing electronic mail in small computers in the homes of these kids so the teacher can communicate by E Mail with the parents, and back and forth. They found that some children who really hadn't had the opportunity to develop verbal skills, writing skills and the likes, and had very low self-esteem, blossomed with the opportunity to interact with a computer and interesting software.

They said it is unbelievable how fast these kids adapted. You almost have to keep the adults out of the classroom because these kids are moving so fast. And that E Mail with the parent means the teacher sends a message to the mother and father at home, and they get an answer pretty fast. So the question is as the cost of these things comes down, aren't we missing a bet if we fail to link our schools and parents and kids?

Kids no longer have to all move at the same time in the same place. They can move individually because you can individualize instruction. It is like modern manufacturing. We can abandon Henry Ford's maxim that you can have any color Ford you wanted as long as it is black.

We now individualize production because we have that flexibility. Well, the same holds in instruction. I know that Secretary Riley and Governor Kunin are very interested in this. I know the Defense Department is interested in transferring their knowledge. I know the computer industry has a self-interest. But I think it's a rational self-interest, as well, in seeing more of this technology really reach the kids and give these kids, especially the disadvantaged kids, a chance to develop a much better sense of self-worth and skills of expression, which are the bottom line for so much of education.

OSTP'S BUDGET REQUEST

Mr. STOKES. Right.

Let's now turn to the budget questions. And we are turning specifically to the appropriation request of the Office of Science and Technology Policy. OSTP requests $5,170,000 in 1994, $945,000 more than the 1993 appropriation of $4,225,000, excluding the CIESIN grant.

The duties of National Space Council and the National Critical Materials Council will be absorbed by OSTP, reducing appropriations by a $1,591,000. The net result is a decrease in appropriations by $646,000.

The President announced on February 9th a 25 percent reduction in White House staff, including a 52 percent reduction in science personnel. This meant for OSTP a reduction from 95 people on board, 47 full-time staff, with 48 consultants to 46 on board, 40 staff and six detailees; is that correct?

Mr. GIBBONS. Yes, sir.

Mr. STOKES. How many of the cut positions, Dr. Gibbons, were unpaid consultants?

Mr. GIBBONS. Mr. Chairman, I would say I would have to look—may I ask my able administrative officer?

Mr. STOKES. Sure.

Ms. FERGUSON. At the Space Council, 33 positions were unpaid expert advisers OSTP dropped 6 consultants.

Mr. GIBBONS. This is Barbara Ferguson, the Administrative Officer.

Mr. STOKES. Can you tell us how many were detailees paid at 50 percent of their total costs, or if you would provide that for the record?

Ms. FERGUSON. Yes, sir. OSTP staff fluctuated between 9 and 12 detailees, and now we have been cut to no more than 6. The National Space Council had 6 detailees, and all were cut. The National Critical Materials Council had no detailees.

Mr. GIBBONS. So it is roughly half?

Ms. FERGUSON. Right.

Mr. STOKES. How about your full-time direct hire positions?

Ms. FERGUSON. We had not gotten to our full-time FTEs. It essentially didn't get cut.

Mr. STOKES. How much was it?

Ms. FERGUSON. We had gotten them to 33 full-time.

Mr. STOKES. Can you tell us the ceiling?

Ms. FERGUSON. Our ceiling was 43 and now we have been cut down to 40.

Mr. GIBBONS. That was just to the OSTP?

Ms. FERGUSON. Right.

Mr. STOKES. All right. Now, it seems that the bulk of the cuts were taken from unpaid staff and detailees rather than direct hires. Can you tell us why?

Mr. GIBBONS. Well, we simply went along with the White House accounting. They looked at the personnel office roster of people, and we understood that the reductions were not across the board within the White House. They simply wanted to streamline the place and reduce the total number of people involved, and we said we would obviously go along with the rest.

At the same time, with the merger of the three offices and with the increased attention given to science and technology in the White House operations, we were spared some of the harder hits. In fact, the cuts were not easy on us but we were spared some of the harder hits of the other parts of the organization.

I have not completely finished my work on reorganizing our own office, as I think you understand, since we have the Space Council work to undertake. But I do believe that the allotment given to us by the White House for 40 full-time staff will enable us to carry out our work if we do have this small amount of flexibility for contracting when we have a particular need for someone we can't get in some other way.

STAFFING REDUCTIONS

Mr. STOKES. Doctor, how would you characterize these staffing reductions as doing more with less, or as shifting responsibilities from the White House to line agencies.

Mr. GIBBONS. I would say the White House is committed to supporting the line agencies. For instance, we see our work in the FCCSET area as catalyzing assistance to the agencies in carrying out the work. At the same time, I believe the White House has in fact effectively streamlined their operations and ours is just but a small example where we have what once were three different activities with their administrative overheads and the like reduced to a single organization. And we in turn are trying to do our best to link ourselves with our counterparts in the National Economic Council.

So I think what you see in the White House as this thing works out during the fiscal year, is a decreased layering of activities within the White House, a smaller net number of people there, and indeed as for those left, as far as I can tell, increased responsibilities.

I certainly went in thinking I was going to have two titles and then ended up with four. But I am sympathetic with the President's concern that the White House be a supportive group, an integrative group, a coordinating group, but the work gets done in the agencies.

Mr. STOKES. Okay. In spite of the cut in personnel, OSTP has requested an additional $945,000 for salaries and expenses, largely to increase the number of SES employees from four to eight, and the number of senior GS–15 policy analysts from 4 to 14. Are these figures correct?

Mr. GIBBONS. Yes, sir, I believe those are correct. I will be happy to check to see.

Ms. FERGUSON. That is counting detailees in that number. OSTP would have four hires at the SES level, 4 detailees at the SES level, 12 GS–15 policy analysts hired, and 2 detailed policy analysts.

Mr. GIBBONS. So it is correct but under that it includes the detailees.

Mr. STOKES. Sure. All of these new hires would be managers at most other Federal agencies. Tell us why it is necessary to expand the size of mid-level management so rapidly while shrinking the rest of the work force?

Mr. GIBBONS. Well, my concern is that as we are asked to coordinate and in fact lead at policy level the executive agencies in a lot of complex areas of science and technology. We need people who have the requisite qualifications for carrying out that kind of work.

It was my statement to the White House that as they increase our responsibilities, not only in size but in terms of senior policy-level activities, that a decrease in work force is going to be manageable if we are able to increase the seniority, as it were, of the people we have. Because if you are going to work at the deputy level or the Secretary level, then you need people who can be effective in that environment. And a lot of our people, as you understand, hold multiple degrees in terms of not only Ph.Ds, but M.D.s and the likes.

In other agencies their compensation is provided by a variety of mechanisms and we are very constrained in that regard. We have no exempt status employees in our place, for instance, compared to the CEA or other organizations.

RESPONSIBILITIES IN SPACE AND MATERIALS

Mr. STOKES. OSTP will absorb the responsibilities of the National Space Council and the National Critical Materials Council. How large a dedicated staff do you expect to devote to space?

Mr. GIBBONS. I still have to work that out, but I believe probably one assistant director level person and then people who are experienced in space that are embedded in our directorates—environment, national security, technology and science. Space pervades all of these areas of technology and I would see it as a distributed function in OSTP rather than some stand-alone activity.

Mr. STOKES. Doctor, how many staff will you dedicate to the work of the old Critical Materials Council?

Mr. GIBBONS. I will see that as embedded as a portion of the people that are involved in the physical sciences and engineering, primarily, but also in terms of our work in biology and biotechnology. I would see that as a distributed activity again that would partially account perhaps for one or two people.

I don't know how it would add up in total but it would not be a stand-alone activity but rather contained mostly in our physical sciences and engineering.

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY

Mr. STOKES. Now, your budget contains no funding requests for the President's Council of Advisors on Science and Technology and its executive order expires in June. Do you plan to renew it or do you intend to create a new advisory mechanism?

Mr. GIBBONS. I am presently in discussion with people from the White House, from the National Science Board, from the National Academy of Sciences and from our own staff about the historic role PCAST and its predecessors have played and, the role or roles that the National Science Board, for example, has played in the past or could play in the future.

I certainly want to be able to advise the President well before the executive order ends in June. But, honestly, I have simply put that off until I had a better feeling for what the requirements will be on me in absorbing the Space Council, for example.

I would hope that if we do recast the present advisory group, that we will be able to do it in a way that will capture all of these additional responsibilities that have been assigned to us.

I am just not convinced yet about exactly where we ought to go with this, Mr. Chairman. I am in dialogue, as I mentioned, with the National Science Board which has a charter, which includes, for instance, its ability to assist OSTP and with the Academies of Science and Engineering.

FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY

Mr. STOKES. Okay. Dr. Gibbons, OSTP chairs 11 committees and 41 subcommittees and working groups with the Federal Coordinating Council for Science, Engineering, and Technology. All the funding and a vast majority of the staffing for each committee resides with other agencies. I understand the need for all Federal agencies to collaborate to create complementary rather than duplicative policies, but what is the advantage of having OSTP as opposed to a line agency chair these meetings?

Mr. Gibbons. I would be delighted to be spared of some of this activity. What the agencies I think logically look is for the White House to provide a convening mechanism for them to work together on these issues. And we find frequently that we simply play a catalytic role. We don't have one person for every one of those subcommittees or that would eat up our entire staff and all our operations.

What we are able to do is help orchestrate a group that can meet, as it were, in neutral territory. We help pick the chairs, so they can honestly support these things and not feel as though one agency or another is unfairly gaining territory in the process.

Mr. Stokes. That then leads us to our next question which is realizing that interagency meetings often require an honest broker, but OSTP precisely because it does not have line responsibilities can become insensitive to implementation problems. How do you guard against that?

Mr. Gibbons. Well, one way to guard against it is to try to understand the issues at hand and rather than try to manage these situations, organize a grouping and a chairmanship or a co-chairmanship that is designed to help make it work right.

For instance, in one case, we have an activity we are presently working on about an advanced automobile. Two agencies that must clearly be involved in it are Commerce and Energy. We don't want to have the chairman from one or the other of those because they might feel that is kind of a territorial struggle. So at present we have a very senior industrial engineer from the National Science Foundation who is chairing that activity. This gives you, as it were, a well-regarded but neutral third party to help in the convening process.

What we are trying to do is to provide enough of the presence of the White House for these agencies to know that we are serious about what is going on and that OMB is looking over everyone's shoulders as well. Everyone has a lot at stake in making the system as a whole work and therefore that they will come to the table.

In times past, the FCCSET process has not worked so well in some instances because the agencies have felt that it was not that much in their self-interest to be involved. We hope that they are going to understand that they have a substantial self-interest, and that requires us to devise a process that they can see as being potentially very helpful to fulfill their own mission objectives.

Mr. Stokes. Doctor, for our last question, not really a question, we are going to ask you to provide a breakdown for the record of your current and proposed staffing by grade, gender and ethnicity.

Mr. Gibbons. All right, sir, be happy to provide that to you.

[The information follows:]

POSITION	CURRENT GRADE	CURRENT GENDER	CURRENT ETHNICITY	PROPOSED GRADE	PROPOSED GENDER	PROPOSED ETHNICITY
Director	EX-2	Male	Caucasian	EX-2	Male	Caucasian
Associate Dir. Science-Acting	SES-6	Male	Caucasian	EX-3	Vacant	
Associate Dir. Nat'l Sec & Int'l	Consultant	Male	Caucasian	EX-3	Vacant	
Associate Dir. Technology-Desig	EX-3 Det'l	Male	Caucasian	EX-3	Male	Caucasian
Associate Dir. Environment	EX-3	Vacant		EX-3	Vacant	
Asst. Dir. Life Sciences	SES-3	Vacant		SES-3	Vacant	
Asst. Dir. Environment	SES-4	Female	Caucasian	SES-2	Male	Caucasian
Asst. Dir. Nat'l Security-Acting	GS-15	Male	Caucasian	SES-3	Vacant	
Asst. Dir. Technology	SES-3 Det'l	Male	Caucasian	SES-3	Male	Causasian
Special Asst. to Director	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Executive Asst. to Director	GS-14	Female	Caucasian	GS-15	Female	Caucasian
General Counsel	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Intergovernmental Affairs/Pol	GS-15	Male	Caucasian	GS-15	Male	Caucasian
Administrative Officer	GS-14	Female	Caucasian	GS-15	Female	Caucasian
Asst. Dir. Social Science	GS-15	Vacant		GS-15	Vacant	
Senior Policy Anal. Science	LtCol-Det'l	Male	Caucasian	GS-15	Vacant	
Senior Policy Anal. Science	GS-14-Det'l	Male	Caucasian	GS-15	Vacant	
Senior Policy Anal. Intern'l	GS-15	Male	Caucasian	GS-15	Male	Caucasian
Senior Policy Anal. Technology	Consultant	Male	Caucasian	GS-15	Male	Caucasian
Senior Policy Anal. Environmt	GS-15	Vacant		GS-15	Vacant	
Exec. Secty. PCAST	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Senior Policy Anal. PCAST	GS-9	Male	Caucasian	GS-14	Vacant	
Information Mgmt Specialist	GS-12	Male	Amer Indian	GS-13	Male	Amer. Indian
Confidential Asst. Director	GS-12	Female	Caucasian	GS-12	Female	Caucasian
Confidential Asst. Technology	GS-12	Vacant		GS-12	Vacant	

POSITION	CURRENT GRADE	CURRENT GENDER	CURRENT ETHNICITY	PROPOSED GRADE	PROPOSED GENDER	PROPOSED ETHNICITY
Confidential Asst. Environment	GS-12	Female	Hispanic	GS-11	Vacant	
Confidential Asst. Science	GS-10	Female	Caucasian	GS-11	Female	Caucasian
Confidential Asst. Nat'l Sec. & International	GS-10	Female	Caucasian	GS-11	Female	Caucasian
Secretary Environment	GS-10	Female	Black	GS-10	Female	Black
Administrative Asst. Personnel	GS-8	Female	Caucasian	GS-9	Female	Caucasian
Administrative Asst. Budget	GS-8	Vacant		GS-9	Vacant	
Secretary Science	GS-8	Female	Black	GS-8	Female	Black
Secretary Nat'l Sec. & Intern'l	GS-8	Female	Caucasian	GS-8	Female	Caucasian
Secretary Technology	GS-8	Vacant		GS-8	Vacant	
Secretary PCAST	GS-8	Female	Black	GS-8	Female	Black
Administrative Asst. Security	GS-8	Vacant		GS-8	Vacant	
Correspondence Asst. Dir.	GS-13	Female	Caucasian	GS-8	Vacant	
Secretary Administration	GS-7	Vacant		GS-7	Vacant	
Administrative Asst. Security	GS-6	Vacant		GS-6	Vacant	
Clerk-Typist	GS-4	Male	Black	GS-5	Male	Black
DETAILEES						
Asst. Dir. International	SES-3	Vacant		SES-3	Vacant	
Asst. Dir. Phys Sci & Eng	SES-3	Male	Caucasian	SES-3	Vacant	
Special Asst. Space	SES-1	Male	Caucasian	SES-1	Male	Caucasian
Special Asst. Defense Conv.	SES-2	Female	Caucasian	SES-2	Female	Caucasian
Senior Pol Anal Technology	GS-15	Vacant		GS-15	Vacant	
Senior Pol Anal Nat'l Security	GS-15	Vacant		GS-15	Vacant	
Special Assistant to Director	GS-14	Male	Caucasian	——	——	——
Policy Anal. Physical Sci. & Eng	GS-12	Female	Caucasian	——	——	——

The Office of Science and Technology Policy will take into consideration the Administration's desire for ethnic and gender diversity when filling vacancies at all levels within the office.

Mr. Stokes. Thank you.

Mr. Mollohan?

Mr. Mollohan. Mr. Chairman, I have a couple of questions that I would like to submit for the record.

Mr. Stokes. All right. Sure. That may be done.

[The information follows:]

Congressman Alan B. Mollohan

QUESTION: TECHNOLOGY POLICY

I am pleased that the Clinton Administration is taking the necessary steps to lead the Nation in a bold new direction to refocus our priorities, particularly in the area of "technology policy."

Time and time again, Congress has heard testimony suggesting that while our Nation is superlative at the "R" of "R&D," our competitors maximize on the fruits of our research by being more efficient at the "D" of "R&D."

In reviewing the President's "Technology Initiative," it becomes clear that this Administration is going to invest heavily in new technology development. It is also clear that this Administration will take major steps to redefine the relationship between government and industry.

Can you please comment, for the record, on how this Administration, and its "Technology Initiative," will specifically address the difficulty our Nation faces in commercializing the fruits of our research?

ANSWER

The Administration has identified several methods to improve commercialization of research results. We intend to promote regional technology alliances explicitly designed to promote the commercialization and application of critical technologies. In these alliances, regional clusters of strength are identified and firms and research institutions within a particular region are encouraged to exchange information, share and develop technology, and develop new products and markets. We also intend to expand the agile manufacturing program to allow temporary networks of complementary firms to come together quickly to exploit fast-changing market opportunities. These programs support the development and dissemination of information technology and technical standards to make such networks possible.

We also recognize that tax, trade, and regulatory policies influence the commercialization of research. We intend to review a variety of laws -- the tax code, antitrust, intellectual property protections, health and safety regulations -- to determine which are helping and which are hindering accomplishment of national goals, including economic competitiveness.

QUESTION: COMPETITIVENESS: COORDINATION

One of this Administration's significant challenges will be to coordinate the competitiveness strategy to avoid duplicative programs. The federal government has many existing resources which must be integrated into the new competitiveness agenda. Further, the Federal agencies must coordinate their activities strategically so that we do not invest in new programs that duplicate and overlap one another.

Such coordinating challenges are typically addressed by the establishment of a "FCCSET" initiative, with OSTP directing and coordinating the activity. However I have heard other entities mentioned in terms of leadership roles in the competitiveness agenda: the National Economic Council, the Commerce Department, ARPA (for Defense Conversion), to name a few.

Can you please describe, for the record, how the Clinton Administration plans to coordinate the competitiveness activities throughout the Federal government? I would appreciate our also addressing, in particular, how the Administration intends to avoid duplicative efforts.

ANSWER

OSTP, using FCCSET and other mechanisms, will coordinate science and technology programs across the government. This will, of course, entail a major share of the coordination of competitiveness activities. For instance, a FCCSET committee coordinates a program for advanced manufacturing technologies, including the clean car initiative which is designed to help American automobile manufacturers regain world markets while eliminating pollution problems.

The National Economic Council (NEC) will also exercise coordination responsibilities, but will not displace the line agencies, such as Commerce or ARPA, as they take the lead in implementing competitiveness programs. Since the Director of OSTP is a member of the NEC, it will be possible to identify where coordination efforts overlap or duplicate one another. We believe that as we are better able to direct government resources toward national goals rather than agency missions, as has been the case most recently in R&D spending, the instances of program duplication will diminish markedly.

QUESTION: HPCC

Regarding the High Performance Computing and Communications initiative, I am interested in learning about how the Administration will enable the deployment of the National Research and Education Network. In particular, I would like to better understand the role that the government will directly play in the deployment of the "information highway" infrastructure. Further, I would like to know what the private sector's role should be in the deployment of the "information highway" and I would like to understand what policies the Administration will pursue to incentivize the private sector to fulfill this role.

Congressman Alan B. Mollohan

ANSWER

Work on the National Research and Education Network (NREN) is coordinated through the FCCSET initiative on High Performance Computing and Communications (HPCC). The goal of the NREN program is to extend U.S. technological leadership in computer communications by developing a reliable state-of-the-art Interagency Interim National Research and Education Network (IINREN) and by developing a gigabit (a billion bits per second) network. IINREN will provide researchers and educators at all levels with access to computations, scientific, and information resources. NREN is only part of the National Information Infrastructure Initiative, which has as a larger goal providing every American access to an unprecedented amount of information as well as the tools needed to effectively process and use that information.

Close cooperation between the federal agencies and industry is essential if technology developed by the HPCC initiative is to be effectively used by the private sector to build an advanced national information infrastructure. Both individually and as members of the HPCC initiative, the agencies collaborate with industrial partners, fund research and development in the private sector, and work with representatives in planning the HPCC initiative. The NREN and gigabit testbeds are jointly managed by HPCC agencies and the private sector. Frequent meetings are held with the private sector and academia, including biannual presentations by major computer vendors and a forthcoming Grand Challenges workshop. Private sector consortiums and academic forums regularly provide analyses and opinion about the initiative. Representatives from the private sector and academia serve on advisory boards within individual agencies.

We are finding that a voice in determining the government research agenda provides major incentives for private investment. We also believe that efforts described in the technology initiative to create a more favorable business climate -- e.g., better tax, trade, and regulatory policies -- will provide incentives for private investment.

HEARING CONCLUDES

Mr. Stokes. Dr. Gibbons, that completes our hearing. We have had a good hearing, I think, and it has been a pleasure to have you before the subcommittee.

Mr. Gibbons. Mr. Chairman, I thank you for having me here today. I hope I will have some more definitive answers for you in the intervening months. I look forward to working with you.

Mr. Stokes. We look forward to that, too.

All right. We are adjourned until 10:00 o'clock tomorrow morning.

Thank you.

[Questions and budget justifications for the record follow:]

Congresswoman Marcy Kaptur

QUESTION

1) I understand that Advanced Manufacturing is one of your new FCCSET initiatives. As you know, improving manufacturing technology in our country has been identified as a priority for NSF and is a priority for this Committee as well.

Expand on OSTP's Manufacturing initiative. How much does the United States spend on investment in manufacturing technologies?

ANSWER

Advanced Manufacturing Technology (AMT) is the newest of the six science and technology initiatives that have been developed and coordinated through the interagency process of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). In selecting manufacturing as an initiative for the Fiscal Year 1994 Budget, the FCCSET recognized the central place of this sector in the U. S. economy. Indeed, the United States was the unchallenged world leader in manufacturing for many years. This performance has slipped, however, in recent decades.

The United States now has an unprecedented opportunity to accelerate the development and application of advanced manufacturing technologies -- the processes, information, and equipment needed for future competitiveness. By utilizing the Nation's technological strengths and a properly timed and coordinated research and development (R&D) program, industry, government, and academia can work together as a national team to help U. S. manufacturers play an enhanced role in domestic and international markets.

The new Advanced Manufacturing Technology Initiative was developed to seize this opportunity in recognition of the critical role that technology must play in stimulating and sustaining the long-term economic growth that creates high-quality jobs and protects the environment. The AMT Initiative is an R&D program that will help industry harness technology to improve the Nation's economic strength and quality of life.

The President's FY 1994 budget request for the AMT Initiative is $ 1.39 billion. The total national expenditure on manufacturing technologies is obviously larger, but the data are not readily available. The Bureau of the Census has conducted two surveys on manufacturing technology. The first survey, published in 1989, addressed the prevalence of certain manufacturing technologies. The second survey, which is expected to be published in a few months, deals with factors affecting the adoption of manufacturing technologies. This second survey requested estimates of the range of total investment in technologically advanced equipment and software for the preceding three years.

The AMT Initiative will help foster a dramatic shift in the way products are manufactured in the future, supporting the transition from rigid mass production to flexible manufacturing. Driven by increased global competition and major advances in underlying technologies such as computer hardware and software, wide-bandwidth communications, sensors, product and process design, and information processing, this shift will result in highly competitive manufacturing enterprises, capable of responding quickly and cost-effectively to rapidly changing market demands.

QUESTION

2) I understand that the Critical Technologies Institute has now been established and that it will be chaired by you. As you know, there have been many reports issued on what composes the critical technologies in the United States. One such report by the Council on Competitiveness, entitled, "Gaining New Ground: Technology Priorities for America's Future" concluded that we are falling behind our competitors and need to do more to regain our preeminence in critical technologies. The Council identified 23 critical technologies and compared those with the priorities of DoD, Dept. of Commerce, the Japanese Ministry of International Trade and Industry (MITI) and the European Community. Many of the priorities are the same, but each has different programs to promote them.

In a general sense, what is the role of OSTP in providing the necessary guidance to help U.S. industry regain lost ground and ensure our ability to compete in the future? What kind of support will the Critical Technologies Institute give to the Administration? Will it identify another set of critical technologies?

ANSWER

OSTP is attempting to devise the most effective way of working with the CTI, a small resource consisting of 10 full-time individuals and access to another 6 on a matrix assignment basis. OSTP requires CTI's resources on a continuous basis to support our increased responsibilities and activities. We will utilize the critical technologies list as a check list to ensure there is appropriate Federal R&D related to each of them. The critical technologies are "critical" because they must be imbedded in the competence of the private sector for the Nation to compete effectively in the world economy. Such technologies are also critical to maintaining an ability to design and build systems to meet our future defense needs.

OSTP expects to join the critical technologies with the technology initiatives, which will give the list usefulness beyond a robust R&D agenda. The first of these efforts begins with the clean car project. The technology initiatives will also disclose additional technologies meriting consideration as critical technologies.

Congresswoman Marcy Kaptur

QUESTION

3) During testimony before the House Science Committee, you indicated that one of the tenets of President Clinton's technology initiative was to improve partnerships between industry and agency laboratories. How do you propose to do this? What strategy do you have in mind to provide opportunities for our industries to take advantage of agency research? Furthermore, during hearings last year, your predecessor, Dr. Bromley, stressed the need for industrialists and academics to be involved early in the process of determining priorities for the federal laboratories. Industry and academia should be involved in the decision on what projects to undertake. Do you support that argument and if so how will that be part of the President's technology initiative?

ANSWER

The administration is committed to improving the degree of interaction between the Federal research establishment and the private sector. As outlined in the technology initiative, our strategy includes: 1) instructing government agencies to achieve a 10 to 20% outreach in their research to be sure it is relevant to the needs of the nation, the economy, and the private sector research agenda; 2) improving mechanisms, including CRADAs and consortia, that enable industry to work with the federal research establishment; 3) improving the consultative process between the public and private sector regarding the national research agenda, including the use of task forces and industry and professional societies and associations; 4) reevaluating the R&D enterprise of the government against a set of national goals; and 5) using the purchasing power of the federal enterprise where appropriate to pull those technologies to meet national needs into the market place.

QUESTION

4) During a meeting I attended with the Toledo Edison Industrial Systems, the technology transfer organization of the universities and businesses in northwest Ohio, a question was raised on leveling the playing field with respect to technology transfer. There is the concern that other countries research is not readily available to the United States while the United States is more open in allowing access to its research.

In your opinion, how open are other countries to allowing U.S. researchers access to their research? And, what kind of research access do United States government laboratories and private companies give to other countries? Does the U.S.-Japan Science and Technology Agreement provide the framework for reciprocal access?

Congresswoman Marcy Kaptur

ANSWER

European countries are generally open with their research, although there are some exceptions. The United States has been quite open about the research in its government laboratories, with the exception of some research for the national security. This Administration adheres to the fundamental tenet that basic research, wherever performed, should be available to the world as the bedrock of growing knowledge on which all of humanity must build. The United States should lead by example. The decision to share applied research involves balancing national interests with the interests of members of the community of nations. The U.S.-Japan S&T agreement has the potential for increasing reciprocity in research.

QUESTION

5) The Advanced Research Projects Agency (ARPA, renamed from DARPA), NIST, NASA and NSF are collaborating on President Clinton's defense conversion program.

What will OSTP's role be?

ANSWER

In fulfilling its mandate to coordinate science and technology within the Executive Branch, OSTP expects to have an active role in all defense conversion programs. We will work with the relevant agencies through FCCSET and in the new initiatives, such as on developing a clean car and improving learning technologies.

QUESTION

6) On page 14 of the budget justification, it is noted that FCCSET's Committee on International Science, Engineering and Technology (CISET) has produced a report on opportunities for science and technology cooperation with Central and Eastern Europe. What are the findings of that report?

ANSWER

The report, "Opportunities for Science and Technology Cooperation Between the United States and Central and Eastern Europe," was prepared by the FCCSET Committee on International Science, Engineering and Technology (CISET) and transmitted to OSTP on September 1, 1992.

Congresswoman Marcy Kaptur

The report concluded that S&T cooperation offered a unique opportunity to help foster long-term stability in the emerging democracies of Central and Eastern Europe by supporting industrial growth; foreign investment; expansion of markets to encourage consumption of domestic and international goods and services; and improved natural resource conservation and management. Private sector involvement to help revitalize S&T in the region was also recognized as critically important.

A synopsis of the major report recommendations follows:

- enhanced S&T cooperation and assistance should be a high priority for the U.S. government to help build a strong S&T base, foster economic growth, and promote political stability in the region;
- increased S&T cooperation should be mutually beneficial and responsive to the needs of the countries in the region, and include specific activities such as exchanges of scientists and engineers; linkage to global and U.S. information networks; assistance in the establishment of effective science administration and peer-review processes; joint research projects of mutual interest, and encouragement of industry and university cooperation;
- in close coordination with relevant domestic and international organizations, U.S. S&T agencies should build upon their historically productive and cost-effective relationships in the region, and manage their resources to increase involvement of the U.S. university and industry scientists and engineers.
- the U. S. Department of State's Coordinator for Assistance to Central and Eastern Europe should establish a consultative group of technical agencies to advise on priority S&T cooperation and assistance activities, encourage private sector support, and contribute expertise to multilateral initiatives for the region of importance to the U.S.
- foreign assistance funds might be used by the technical agencies to support S&T activities with development objectives in the region;
- the U.S. Government should establish, from available or presidentially-requested resources, a new funding mechanism to support S&T institution-building cooperation in the region.
- the OSTP Director should work with technical agencies, OMB, State Department and private sector advisors to select the most effective funding mechanism involving both U.S. public and private institutions. The President's Science Advisor should encourage non-governmental contributions to such a mechanism.

Congresswoman Marcy Kaptur

QUESTION

7) On page 19 of the budget justification, you make reference to the issuance of a report entitled "Strategy to Stimulate Competitive Research in Selected States." The justification says that the report examined the distribution of federal R&D funding relative to the (state-by-state) distribution of population and various federal programs designed to broaden the distribution of funds.

Please expand on the conclusions of the report and what the OSTP can do to stimulate competitive research in States that have not received their apparent fair share of funding.

ANSWER

Because Federal R&D funds are an investment in the Nation's future, it is not appropriate to think of their allocation in terms of "fair share" or "even distribution," as if they could be "consumed" by every citizen.

Rather, precisely because of the investment character of Federal R&D funds and the need to maximize returns on that investment, it is essential that funds for the conduct of research be targeted deliberately to the researchers best able to meet the nation's needs. It is from these scientists and engineers that we can expect the innovative intellectual breakthroughs that serve to maintain U.S. scientific and technological leadership and increase U.S. competitiveness in global markets. Thus, the most fundamental principle in the allocation of R&D funds is to review the technical merit of the proposed research, the qualifications of the researchers, and the adequacy of their facilities. The support of second rate research will not serve the nation well.

That being said, a portion of Federal R&D funds serve to develop and sustain the nation's R&D infrastructure -- university capabilities and human resources. In this area, some concern for geographical considerations are appropriate. There are several reasons that it is in the interest of the Nation to have a broadly distributed, high-quality, R&D capability. One is that each region, state, or locality depends in part on the proximity of universities, federal laboratories and other R&D institutions and personnel for technical knowledge and new ideas that can support the needs of local industry and economic growth in the region. Another is that talented young students, of each gender and every race and ethnic group, can be found throughout the population. To draw fully on that talent pool, the Nation needs, for instance, to have its universities -- those institutions where the research and education functions are mutually reinforcing -- well dispersed relative to the distribution of that talent pool.

Congresswoman Marcy Kaptur

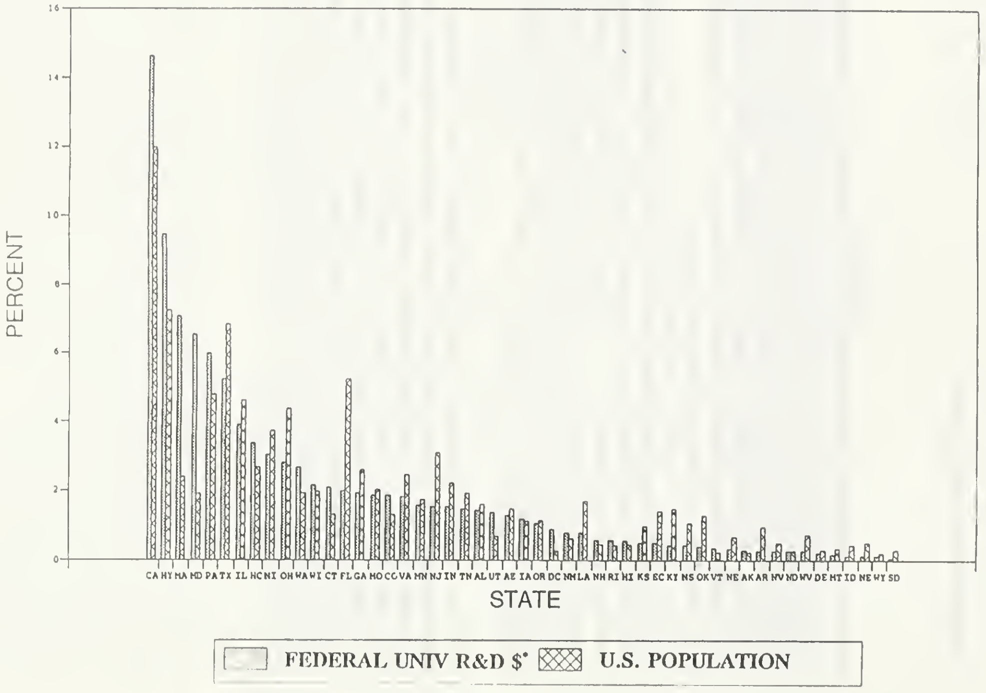
Some have argued for a more even state-by-state distribution of federal R&D funds. Given the fact that the individual population of our states ranges from a half million to thirty million, a state by state comparison is of little relevance. It is for this reason that, instead, the OSTP report presented data (Figure 1 and Table 1) as a function of the population of each state. The broad lines of the two distributions -- Federal R&D funds and state populations -- are not dissimilar, though a number of states receiving relatively less federal R&D resources are significantly outside the norm.

The report addresses the Experimental Program to Stimulate Competitive Research (EPSCoR), an R&D grant program employing merit review procedures aimed at States with relatively less Federal R&D resources. The EPSCoR and EPSCoR-like program described in the report are targeted on many of these "discrepant" cases and are aimed, not at arbitrarily reallocating federal funds to certain states, but rather at improving the capabilities of institutions in those states to compete more effectively for federal funds allocated on a strict merit-reviewed basis.

OSTP has supported decisions by federal R&D agencies to maintain and develop EPSCoR-type programs that enhance the capabilities of institutions in certain states and regions. This underlines the fact that Federal R&D funds serve, in part, to sustain and develop the R&D infrastructure of the United States, and not just to procure research results in the short-term. Consistent with merit-based review, all R&D agencies should make longer term investments in the country's physical and human infrastructure. Geographical distribution -- based broadly on population -- is one important factor in this process. Vigilance will be required, however, in reviewing periodically these efforts, using strict measures to assess their quality and to insulate them from "pork barrel" political pressures.

Figure 1

1990 COMPARISON OF FEDERAL UNIVERSITY R&D FUNDING
AND U.S. POPULATION BY STATE



* $ reflect actual FY 1990 obligations

Table 1
FY 1990 FEDERALLY SUPPORTED UNIVERSITY R&D, PER CAPITA, BY STATE*

STATE	TOTAL FED. UNIV. R&D ($K)	1990 FED. R&D $ (PERCENT)	US 1990 CENSUS POPULATION	1990 US POPULATION (PERCENT)	1990 FED. R&D $ PER PERSON	NORMAL R$/PERSON (NATL AVG)
	9,009,209	100	248,709,873	100	$36	1.0
AL	129,701	1.4	4,040,587	1.6	$32	0.9
AK	25,060	0.3	550,043	0.2	$46	1.3
AZ	115,683	1.3	3,665,228	1.5	$32	0.9
AR	23,586	0.3	2,350,725	0.9	$10	0.3
CA	1,317,326	14.6	29,760,021	12.0	$44	1.2
CO	168,905	1.9	3,294,394	1.3	$51	1.4
CT	189,462	2.1	3,287,116	1.3	$58	1.6
DE	17,922	0.2	666,168	0.3	$27	0.7
DC	78,658	0.9	606,900	0.2	$130	3.6
FL	181,474	2.0	12,937,926	5.2	$14	0.4
GA	176,136	2.0	6,478,216	2.6	$27	0.8
HI	48,276	0.5	1,108,229	0.4	$44	1.2
ID	10,381	0.1	1,006,749	0.4	$10	0.3
IL	351,598	3.9	11,430,602	4.6	$31	0.8
IN	138,349	1.5	5,544,159	2.2	$25	0.7
IA	106,735	1.2	2,776,755	1.1	$38	1.1
KS	44,005	0.5	2,477,574	1.0	$18	0.5
KY	38,185	0.4	3,685,296	1.5	$10	0.3
LA	69,265	0.8	4,219,973	1.7	$16	0.5
ME	10,197	0.1	1,227,928	0.5	$8	0.2
MD	589,856	6.5	4,781,468	1.9	$123	3.4
MA	635,891	7.1	6,016,425	2.4	$106	2.9
MI	274,276	3.0	9,295,297	3.7	$30	0.8
MN	141,748	1.6	4,375,099	1.8	$32	0.9
MS	36,277	0.4	2,573,216	1.0	$14	0.4
MO	169,883	1.9	5,117,073	2.1	$33	0.9
MT	13,041	0.1	799,065	0.3	$16	0.5
NE	29,379	0.3	1,578,385	0.6	$19	0.5
NV	23,111	0.3	1,201,833	0.5	$19	0.5
NH	52,386	0.6	1,109,252	0.4	$47	1.3
NJ	139,264	1.5	7,730,188	3.1	$18	0.5
NM	69,397	0.8	1,515,069	0.6	$46	1.3
NY	851,970	9.5	17,990,455	7.2	$47	1.3
NC	305,255	3.4	6,628,637	2.7	$46	1.3
ND	22,429	0.2	638,800	0.3	$35	1.0
OH	252,157	2.8	10,847,115	4.4	$23	0.6
OK	35,866	0.4	3,145,585	1.3	$11	0.3
OR	95,772	1.1	2,842,321	1.1	$34	0.9
PA	536,674	6.0	11,881,643	4.8	$45	1.2
RI	51,828	0.6	1,003,464	0.4	$52	1.4
SC	42,705	0.5	3,486,703	1.4	$12	0.3
SD	5,791	0.1	696,004	0.3	$8	0.2
TN	133,724	1.5	4,877,185	2.0	$27	0.8
TX	469,460	5.2	16,986,510	6.8	$28	0.8
UT	122,880	1.4	1,722,850	0.7	$71	2.0
VT	31,687	0.4	562,758	0.2	$56	1.6
VA	166,017	1.8	6,187,358	2.5	$27	0.7
WA	240,010	2.7	4,866,692	2.0	$49	1.4
WV	22,240	0.2	1,793,477	0.7	$12	0.3
WI	197,600	2.2	4,891,769	2.0	$40	1.1
WY	9,731	0.1	453,588	0.2	$21	0.6

*** These Figures Reflect Actual FY 1990 Obligations**

Executive Office of the President

Office of Science And Technology Policy

FISCAL YEAR 1994 BUDGET REQUEST

Submission to the

Subcommittee on Appropriations
Departments of Veteran's Affairs and
Housing and Urban Development, and
Independent Agencies

UNITED STATES HOUSE OF REPRESENTATIVES

March 15, 1993

I. GENERAL STATEMENT

Executive Office of the President
Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was created by the National Science and Technology Policy, Organization, and Priorities Act of 1976 (Public Law 94-282).

The Clinton Administration believes that investing in science and technology is investing in America's future: a growing economy with more high-skill, high-wage jobs for American workers; a cleaner environment where energy efficiency increases profits and reduces pollution; a stronger, more competitive private sector able to maintain U.S. leadership in critical world markets; an education system where every student is challenged; and an inspired scientific and technological research community focused on ensuring not just our national security but our very quality of life. The most important measure of success will be our ability to make a difference in the lives of the American people, to harness science and technology so that they improve the quality of life and the economic strength of our nation.

OSTP supports these objectives by: providing authoritative scientific and technological information, analysis, and advice for the President, for the Executive Branch, and for Congress; participating in the formulation, coordination, and implementation of national and international policies and programs that involve science and technology; maintaining and promoting the health and vitality of the U.S. science and technology infrastructure; and coordinating research and development efforts of the Federal government to maximize the return on the public's investment in science and technology and to ensure that resources are used efficiently and appropriately.

In Fiscal Year 1994, the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), chaired by the Director of OSTP, will be strengthened. At present, FCCSET is sponsoring 6 government-wide efforts to coordinate R&D budgets in areas that overlap individual agency responsibilities. FCCSET initiatives are currently underway in: improving our understanding of the climate system; advanced supercomputers and computer networks; math and science education; materials processing; biotechnology; and advanced manufacturing. OSTP also plans to improve federal government ties with State and local governments and with industry and academia.

The President has directed OSTP to absorb the essential functions of the National Space Council and the National Critical Materials Council by the beginning of Fiscal Year 1994. In addition, OSTP has been charged with a substantial leadership role in developing and implementing the President's comprehensive new technology initiative, Technology for America's Economic Growth: A New Direction to Build Economic Strength.

II. SUMMARY OVERVIEW

Executive Office of the President
Office of Science and Technology Policy

The total FY 1994 budget request of $5,170,000 for the Office of Science and Technology Policy (OSTP) is intended to support 40 professional and support staff for OSTP and 6 detailees. The FY 1994 request represents increases only where they are mandatory.

Over the years, OSTP responsibilities and requirements have grown dramatically. In FY 1992 OSTP convened the following advisory boards and prepared the following reports and studies:

- A High Performance Computing Advisory Board
- A National Critical Technologies Panel
- A report on each major multinational science and technology project, in which the United States is not a participant and which has a total estimated cost greater than $1 billion
- A report on the implementation of the High Performance Computing and Communications Program
- A report on science, mathematics, and engineering education including descriptions of current federal programs
- A report for the President and the Congress on federal global change research priorities, policies and programs
- A report on Science, Technology and Foreign Diplomacy
- A report on the feasibility of using NSF's EPSCOR program as a model for a federal strategy for improving the university research capabilities in states that have historically received relatively little federal R&D funding
- A report on user fees, operating funds, protection of privacy and copyrights, and operation and evolution of the National Research and Education Network
- A report on the implementation of national critical technologies identified in the report of the National Critical Technologies Panel

- A report on the development of interagency initiatives prepared for FY 1993.

The FY 1994 request provides for four Associate Directors -- the full number authorized in the enabling legislation. The FY 1994 request also provides for an estimated 6 assistant directors and several policy analysts, consistent with the current OSTP staffing configuration. The professional staff will be composed of individuals with diverse skills and broad experience. This is essential, given the number and variety of issues addressed by OSTP and the changes in direction from year to year. OSTP utilizes detailees from other agencies to fulfill staffing needs in specialized science and technology areas.

The total OSTP budget request for FY 1994 provides a base of support that will allow OSTP to fulfill its growing responsibilities related to Administration programs, policies, and initiatives involving science and technology, including:

- Making recommendations to the President on current major issues of science and technology policy. This requires a very high level of participation and interaction by OSTP in numerous coordinating groups within the Executive Office of the President and with all Federal government agencies.

- Directing and coordinating the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) and its committees and subgroups. This requires an intensive level of participation, coordination, and guidance by OSTP staff on the various FCCSET committees and subgroups.

- Coordinating the science and technology elements of the President's budget request to Congress with other Federal government agencies and departments.

- Prioritizing and coordinating the different objectives of the Nation's civil, military, and commercial space activities and developing policies that are in the broad national interest.

- Anticipating new science and technology issues, or issues with a significant science and technology component, especially those with a longer-range perspective; and initiating interagency coordination on such issues.

- Developing, planning, and implementing international bilateral science and technology agreements with foreign countries. Interagency coordination, under FCCSET, of science and technology issues in negotiated agreements with foreign countries.

- Preparing reports in accordance with legislative requests or direction.

- Interacting with various science and technology related groups outside of the Federal government.

The responsibilities of the Assistant to the President for Science and Technology and of OSTP have increased in the Clinton Administration. Significant additions to OSTP's responsibilities include:

- The Director of OSTP, as Assistant to the President for Science and Technology, plays an active role in the newly formed National Economic Council.

- OSTP has been directed to complete the absorbtion of the essential functions of the National Space Council and the National Critical Materials Council by the beginning of Fiscal Year 1994. Accordingly, OSTP specific responsibility within the Executive Office of the President will include: review of United States Government space policy, including long-range goals and development of a strategy for national space activities; development of recommendations for the President on space policy and space-related issues; monitoring and coordination of implementation of the objectives of the President's national space policy by executive departments and agencies; and fostering close coordination, cooperation, and technology and information exchange among the civil, national security, and commercial space sectors, and facilitating resolution of differences concerning major space and space-related policy issues. In addition, OSTP will take the lead role in: assisting the President in establishing coherent national materials policies; coordinating Federal materials-related policies, programs, and research and technology activities; and reviewing and appraising the various programs and activities of the Federal government in accordance with the policy and directions given in the National Materials and Minerals Policy, Research, and Development Act of 1980.

- OSTP has assumed additional responsibilities in science and mathematics education, the environment, high performance computing and communications, biotechnology, materials science, and technology, particularly as it affects global competitiveness.

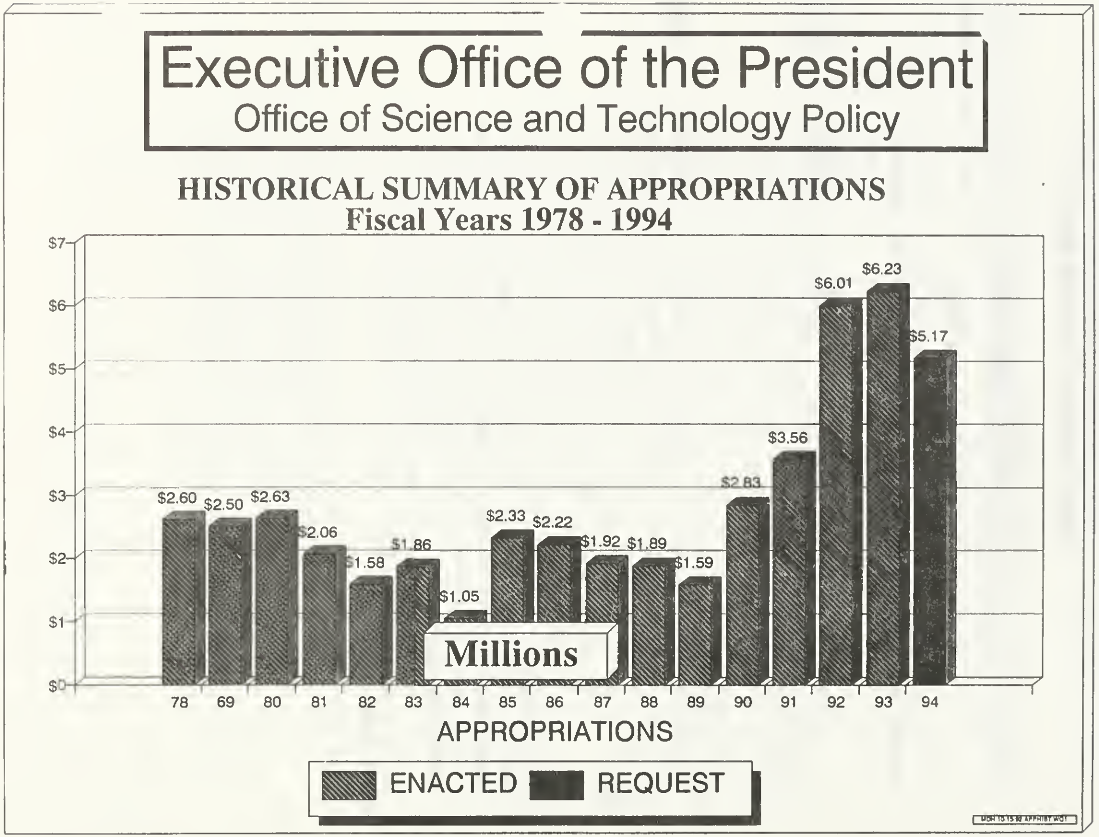
- The Director of OSTP chairs FCCSET, which will have an expanded mission and augmented role in the new Administration.

Executive Office of the President
Office of Science and Technology Policy

BUDGET OVERVIEW

(in thousands of dollars)

	Enacted FY 1992	Enacted FY 1993	Request FY 1994	Net Change FY 93-94
Budget Authority:				
Appropriation	$6,010	$6,225	$5,170	-$1,055
FTE Employment:				
FTP	31	41	40	-1
Other than FTP	3	2	0	-2
Total FTE	34	43	40	-3
Detailee Employment	11	11	6	-5



Executive Office of the President
Office of Science and Technology Policy

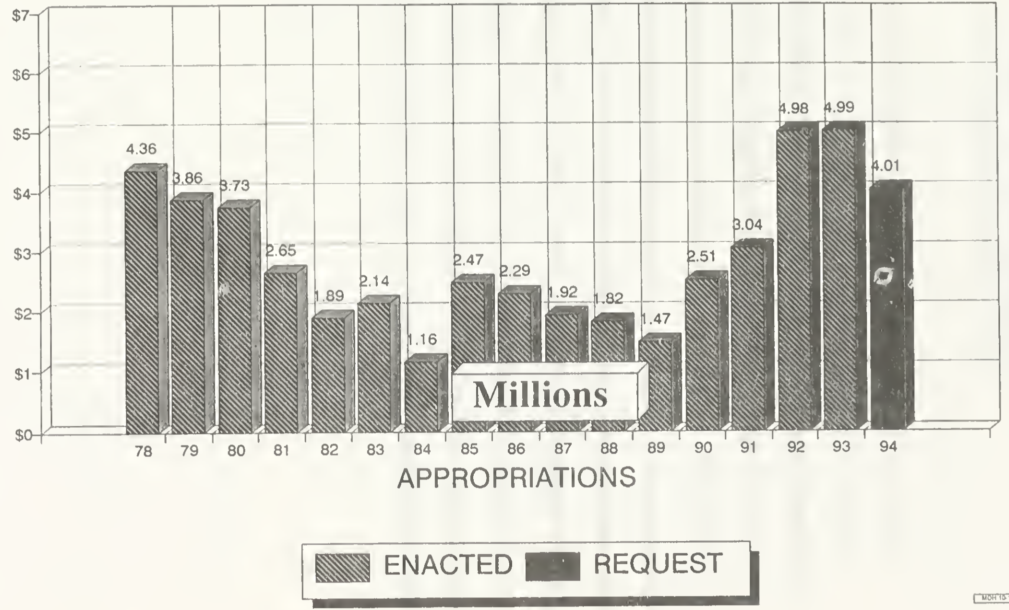
HISTORICAL SUMMARY OF APPROPRIATIONS
Fiscal Years 1978 - 1994

Executive Office of the President

Office of Science and Technology Policy

HISTORICAL SUMMARY OF APPROPRIATIONS

In Constant Fiscal 1987 Dollars



III. APPROPRIATION LANGUAGE

Executive Office of the President
Office of Science and Technology Policy

Salaries and Expenses

For necessary expenses of the Office of Science and Technology Policy, in carrying out the purposes of the National Science and Technology Policy, Organization, and Priorities Act of 1976 (42 U.S.C. 6601 and 6671), hire of passenger motor vehicles, services as authorized by 5 U.S.C. 3109, not to exceed $2,500 for official reception and representation expenses, and rental of conference rooms in the District of Columbia [$6,225,000] $5,170,000: Provided, That the Office of Science and Technology Policy shall reimburse other agencies for not less than one-half of the personnel compensation costs of individuals detailed to it. (Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1993.)

Executive Office of the President
Office of Science and Technology Policy

Program and Performance

The Office of Science and Technology Policy (OSTP) provides advice to the President concerning policies in science and technology and on the utilization of science and technology in addressing important national problems. The OSTP operations include support to other Executive Office of the President organizations on issues with science and technology considerations; review and analysis, with the Office of Management and Budget, of research and development budgets for all Federal agencies; coordination of research and development programs of the Federal Government; coordination of the implementation of a number of important international science and technology agreements; and other activities necessary to carry out the duties, functions, and activities described in Public Law 94-282, the National Science and Technology Policy, Organization, and Priorities Act of 1976.

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STANDARD FORM 300
July 1964, Bureau of the Budget
Circular No. A-11, Revised.
300-101

Office of Science and Technology Policy
Salaries and Expenses
Object Classification (in thousands of dollars)

Identification code 11-2600-0-1-802	19 actual 92	19 estimate 93	19 estimate 94
Direct obligations:			
Personnel compensation:			
11.1 Full-time permanent	1,420	1,658	2,216
11.3 Other than full-time permanent	425	279	174
11.5 Other personnel compensation	94	65	50
11.8 Special personnel services payments	547	537	401
11.9 Total personnel compensation	2,486	2,539	2,841
12.1 Personnel benefits: Civilian	378	430	646
Total Personnel Compensation and Benefits	2,864	2,969	3,487
Non-Personnel Expenses:			
21.0 Travel and transportation of persons	258	250	250
22.0 Transportation of things	3	4	6
23.1 Rental payments to GSA	410	422	445
23.3 Communications, utilities, and miscellaneous charges	190	210	279
24.0 Printing and reproduction	108	80	125
25.1 Consulting services	11	0	140
25.2 Other services	89	100	128
26.0 Supplies and materials	73	90	130
31.0 Equipment	320	100	180
Total Non-Personnel	1,462	1,256	1,683
99.0 Subtotal, direct obligations	4,326	4,225	5,170
99.0 Reimbursable obligations*	1,616	–	–
99.0 One-time pass through grant**	–	2,000	–
99.9 Total Obligations	5,942	6,225	5,170

* FY92 - Critical Technologies Institute $1,600,000 and Vice President's Manufacturing Initiative $16,000

**FY93 - Consortium for International Earth Science Information Network $2,000,000

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STANDARD FORM 300
July 1968. Bureau of the Budget
Circular No. A-11. Revised.
300-103

Office of Science and Technology Policy
Salaries and Expenses

DETAIL OF PERMANENT POSITIONS

11-2600-0-1-802	1992 actual	1993 estimate	1994 estimate
Executive Level II	1	1	1
Executive Level III	4	4	4
Subtotal	5	5	5
ES-4	2	2	2
ES-3	1	1	1
ES-2	1	0	1
Subtotal	4	3	4
GS-15	5	4	12
GS-14	1	2	1
GS-13	2	3	1
GS-12	2	3	2
GS-11	2	1	3
GS-10	1	1	1
GS- 9	4	4	2
GS- 8	4	3	6
GS- 7	1	6	1
GS- 6	3	5	1
GS- 5	0	1	1
Subtotal	25	33	31
TOTAL PERMANENT	34	41	40
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GPO 1970—301-036/3037

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STANDARD FORM 306
July 1968, Bureau of the Budget
Circular No. A-11, Revised.
306-103

Office of Science and Technology Policy
Salaries and Expenses

Personnel Summary
DETAIL OF PERMANENT POSITIONS

11-2600-0-1-802	19 92 actual	19 93 estimate	19 94 estimate
Total number of full-time permanent staff (FTP)	33	41	40
Additional staff (Consultants & premiums)	1	2	0
Total Compensable workyears:			
Full-time equivalent employment (FTE)	34	43	40
Full-time equivalent of overtime and holiday hours	1	1	1
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GPO : 1978—261-838/3037

IV. EXPLANATION AND JUSTIFICATION OF CHANGES BY OBJECT CLASS FOR FY 1994

Executive Office of the President
Office of Science and Technology Policy
(in thousands of dollars)

Increases/Decreases to Maintain Current Services and Requests Levels ($1,055)

The budget shows a decrease because pass-through funds for CIESIN (which received $2M through OSTP's appropriation in FY93) are reflected. OSTP actually seeks a $945K increase in funding.

Within OSTP's operational budget, the larger components of the increase are:

- Transition of detailees and consultants to full-time permanent staff
- Resultant increase in cost of benefits (particularly Thrift Savings Plan matching contributions)

PERSONNEL COMPENSATION

FY '93	FY '94		
$2,969	$3,487	Personnel Compensation	$518

This category includes funding to support 40 full-time equivalent (FTE) personnel for OSTP and 6 detailees.

The increase of $518 reflects the transition of detailees to FTEs and the hiring up to our full FTE strength of 40 positions. OSTP plans to have a more stable permanent staff in place for FY94 than has been the case in previous years.

NON-PERSONNEL EXPENSES

FY '93	FY '94		
$ 250	$ 250	Travel and transportation of persons	$ 0

No change was made in this category. This category supports the: (1) foreign travel associated with the growing number of S&T agreements entered into with other nations; and (2) travel required to implement and monitor agreements with industry and academia to pursue partnerships in S&T.

FY '93	FY '94		
		Travel associated with functions transferred from the National Space Council are estimated to be equivalent, approximately to those formerly required by PCAST.	
$ 4	$ 6	Transportation of things	$ 2
		This category supports shipping and Federal Express expenses. Based on actual FY93 projections, an increase of $2,000 is indicated in this category.	
$ 422	$ 445	Rental payments to GSA	$23
		An increase of $23,000 is anticipated for FY94 rental payments to GSA. This is the result of the scheduled rent increase and the change of space allocated to OSTP within the EOP complex.	
$ 210	$ 279	Communications, utilities, and miscellaneous charges	$69
		This category provides funds for commercial utilities including telephone services (AT&T, FTS); GSA utilities; postage; and data links. An increase of $69,000 is anticipated for FY94. This increase is to cover the increased costs for these services, the increased volume of postage (particularly in response to requests for publications), and increased after hours utilities charges.	
$ 80	$ 125	Printing and reproduction	$45
		These funds provide for government and commercial printing requirements, including reports to the Congress and announcements in the Federal Register. The increase of $45,000 is necessary because of the reports OSTP expects to generate in FY94.	
$ 0	$ 140	Consulting Services	$140
		As OSTP cuts down on the number of detailees assigned from other agencies, OSTP will depend on contracts for specialized deliverables to fill short-term, highly technical information needs.	

FY '93	FY '94		
$ 100	$ 128	Other services	$ 28

This category includes the costs associated with building alterations, equipment repair, including maintenance contracts, training, health services, EOP Office of Administration services, and the representational fund.

An increase of $28,000 is requested for FY94. This increase is necessary for building alterations necessary to accommodate our changing organizational requirements.

It is also necessary to cover the cost of connect charges to InterNet and CompuServe, the costs associated with modem connect time charges relative to data retrieval.

In addition, some specialized training will be required for the OSTP network administrator and the assistant administrator. Based on recommendations by President Clinton's technology task force, OSTP will incur costs associated with technology assessment and upgrade. One of the most important costs associated with this is the training of our staff. We are currently using DOS-based software and will be converting to a Windows-based environment.

FY '93	FY '94		
$ 90	$ 130	Supplies and materials	$ 40

This category includes costs for office supplies, specialized supplies for computer usage (including off-the-shelf software), and newspaper/periodical subscriptions.

An increase of $40,000 is anticipated for FY94. In FY94 there will be a major software upgrade based on the recommendations of President Clinton's technology task force. OSTP must incorporate software upgrades for all staff members in order to comply with plans for a White House/Executive Office of the President complex-wide software interoperable integration. All current OSTP software must be replaced with Windows-based software.

FY '93	FY '94		
$ 100	$ 180	Equipment This category includes equipment (such as computers, telefax machines, dictating equipment, etc.); furniture and fixtures; books; and tools (e.g., for in-house repair of computers). The increase of $80,000 is requested to bring the current sub-standard computer equipment up to the new Administration's standards. The current computer equipment will not accommodate the hardware and software needs of the new Administration.	$ 80
$2,000	$ 0	Consortium for International Earth Science Information Network (CIESIN) This was a one-time pass through in which OSTP made a lump-sum grant.	($2,000)
SUMMARY			
$6,225	$5,170		($1,055)

Executive Office of the President
Office of Science and Technology Policy

SUMMARY OF BUDGET AUTHORITY BY OBJECT CLASS
FY 1992-1994

BUDGET OVERVIEW
(in thousands of dollars)

	FY 1992	Estimated FY 1993	Estimated FY 1994	Net Change FY 93-94
Personnel compensation:				
Full-time permanent	1,420	1,658	2,216	558
Other than full-time permanent	425	279	174	(105)
Other personnel compensation	94	65	50	(15)
Special personal services payments	547	537	401	(136)
Total personnel compensation	2,486	2,539	2,841	302
Personnel benefits: Civilian	378	430	646	216
al compensation and benefits	2,864	2,969	3,487	518
Travel and transportation of persons	258	250	250	0
Transportation of things	3	4	6	2
Rental payment to GSA	410	422	445	23
Comm., util., and misc., chgs.	190	210	279	69
Printing and reproduction	108	80	125	45
Consulting services	11	0	140	140
Other services	89	100	128	28
Supplies and materials	73	90	130	40
Equipment	320	100	180	80
Subtotal, direct obligations	1,462	1,256	1,683	427
Subtotal, all obligations	4,326	4,225	5,170	945
Reimbursable obligations	1,616	0	0	0
SIN Grant	0	2,000	0	(2,000)
Total all obligations	5,942	6,225	5,170	(1,055)

Executive Office of the President
Office of Science and Technology Policy

SUMMARY OF CHANGES FROM FY 1993 TO FY 1994 BY OBJECT CLASS

(in Thousands of Dollars)

	Increases	Decreases	
FY 1993 BUDGET AUTHORITY			$6,225
CURRENT PROPOSED FY 1994			$5,170
Personnel compensation	$ 302	0	
Personnel benefits	216	0	
Subtotal, compensation and benefits	$518	0	
Travel and transportation of persons	0	0	
Transportation of things	2	0	
Rental payments to GSA	23	0	
Comm., util., and misc. charges	69	0	
Printing and reproduction	45	0	
Consulting services	140	0	
Other services	28	0	
Supplies and materials	40	0	
Equipment	80	0	
Subtotal, direct obligations	427	0	
CIESIN Grant	0	2,000	
TOTAL	945	0	
Net Increase/Decrease	0	1,055	

SUMMARY OF ACCOMPLISHMENTS IN FY 1992 BY THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

In Fiscal Year 1992, OSTP employed 40 people, including support staff. OSTP staff support the activities of the interagency Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) and of other advisory committees mandated by legislation or Executive Order. The Director, the Associate Directors, and OSTP's program staff work on issues of national and international interest. The OSTP staff interact with the FCCSET committees, further increasing the cross-fertilization between the different components of OSTP. In addition, OSTP has close working relationships with the Office of Management and Budget (OMB), the National Security Council (NSC), the National Economic Council (NEC), and the Council of Economic Advisers (CEA).

The following pages summarize the activities and accomplishments of the Office of Science and Technology Policy during Fiscal Year 1992, including many of the accomplishments of committees under FCCSET. (Appendix A lists the departments and agencies represented on FCCSET and the FCCSET committees and ad hoc working groups of Fiscal Year 1992.) Accomplishments are organized into subject categories, but the order or length of those categories should not be interpreted as denoting priorities.

The Physical Sciences and Engineering and Industrial Technology

Computing and Communications

FY 1992 was the first year of the High Performance Computing and Communications (HPCC) program, developed under the auspices of the FCCSET Committee on Physical, Mathematical, and Engineering Sciences. As implementation of HPCC proceeded, a number of important supporting activities were initiated. For example, OSTP formed an Administration team to negotiate with Congress on several versions of the authorizing legislation for the HPCC program. The negotiations resulted in the enactment of the High Performance Computing Act. OSTP also provided primary support for review of the HPCC program. Finally, in collaboration with OMB, OSTP led an effort to establish a National Office of Coordination for HPCC. This office was established on September 1, 1992.

Semiconductors

The National Advisory Committee for Semiconductors (NACS), a body made up of leading members of both industry and government, completed its legislatively mandated task of recommending a national strategy for the semiconductor industry. OSTP was the sponsor for NACS and actively participated in its activities throughout its existence.

One of the projects initiated by NACS is Microtech 2000, an effort to develop an industry plan for the development of a leading-edge semiconductor product for the year 2000. The Semiconductor Industry Association (SIA) has inherited the project from NACS and is continuing its development. OSTP has actively worked with SIA on this industry-led effort to chart a technology course for the semiconductor industry.

Optical Computing

In 1991 Japan's Ministry of Trade and Industry (MITI) announced a ten-year program in Real World Computing and invited U.S. participation. Under the charter provided by the U.S.-Japan Science and Technology Agreement, OSTP led an interagency group to formulate a U.S. response. Following extensive consultation with both industry and academia, the United States made a proposal for the cooperative development of an experimental fabrication (prototyping) facility for components of optical computing systems. This is an area where access to Japanese fabrication technology will be critical to the development of a viable U.S. industry in optical computing. A prototyping service would provide a means for access to technology without the threat of its being appropriated. Thus far, MITI's response has been encouraging. A joint feasibility study was concluded in 1992, and U.S. and Japanese teams of 5 members each have been appointed to continue negotiations and establish a framework for the program to move forward.

Materials Science and Engineering

OSTP assisted in preparing the Advanced Materials and Processing Program (AMPP), developed under the auspices of the FCCSET Committee on Industry and Technology (CIT). OSTP and OMB aided and coordinated the interagency process to develop a comprehensive research and development program involving ten agencies and departments that support materials R&D. In follow-up activity, OSTP staff have made presentations describing the AMPP to numerous private sector groups to solicit their reactions, support, and recommendations for further evolution of the program.

During FY 1992 an initial implementation plan was developed to move the program forward and define the metrics against which success will be measured in the future. As part of the plan, several industry-government workshops are being planned to assist in the identification of AMPP programs that merit additional emphasis.

Advanced Manufacturing

OSTP coordinated an interagency discussion within FCCSET that led to a federal program in advanced manufacturing technology. Manufacturing remains the foundation of the American economy, but American industry and government under-invest in manufacturing. This new initiative will accelerate investment in advanced manufacturing technologies that promote U.S. industrial competitiveness and that build on, rather than minimize, worker skills.

Energy

OSTP has worked with the Department of Energy (DOE) and other Executive branch departments in the ongoing development and implementation of a national energy policy, particularly concerning research and development on technologies for generation and more efficient use of energy. Such technologies, from efficient use of energy in Federal buildings to development of a new generation of automobiles that are safe, clean, and rely on domestic fuels, have become major foci of the applied research and development investments proposed in the President's budget.

Space

OSTP works with OMB, the National Aeronautics and Space Administration (NASA), and members of the U. S. space research community to assure a balanced and effective program of space science research and development.

During FY 1992 OSTP participated in activities related to the NASP (the National Aerospace Plane), the Space-Global Change Observation System, U.S.-USSR (FSU) Space Cooperation, Landsat, and space exploration. The OSTP Director maintained a close overview of the NASP program and actively participated in policy discussions. In this capacity OSTP helped address the scientific and technical issues necessary for determining the exit criteria for Phase II of the NASP program.

OSTP actively participated in discussions involving NASA and other agencies on NASA's Earth Observing System (EOS) and its associated Data Information System (EOSDIS).

OSTP worked with OMB to help NASA structure a review of EOSDIS conducted by the National Academy of Science and also participated in technical discussions associated with the EOS program.

OSTP also participated in an Ad Hoc Group on Landsat that coordinated agency interests in Landsat to determine the most effective way of continuing Landsat-type data collection after Landsat 6. This led to the establishment of a joint development effort between NASA and the Department of Defense (DoD) as well as a new management plan to ensure the continuity of Landsat-type data.

OSTP's involvements in scientific and technological aspects of the space program will intensify in FY '93 and beyond since the Office has been directed to assume the essential responsibilities of the National Space Council.

Aeronautics

In the area of aeronautics, OSTP continued to monitor closely the goals established by the Aeronautics Policy Review Committee. This involved frequent contact with senior U.S. aerospace executives, aerospace association presidents, congressional staff, and NASA and DoD officials.

The Critical Technologies Institute

In FY 1992 OSTP acted to establish the Critical Technologies Institute (CTI) as a legislatively mandated FFRDC (federally funded R&D center) to provide analytical support for technology policy-making in the Administration. Following a selection process conducted by the National Science Foundation, the Rand Corporation was selected to provide administrative services for the Institute. CTI will be governed by an operating committee consisting of senior officials of the Administration and chaired by the Director of OSTP. CTI has now begun to carry out its functions.

CFIUS

OSTP participated actively on the interagency Committee on Foreign Investment in the United States (CFIUS), particularly in the case of a proposed acquisition of LTV by Thomsen CSF.

The Life Sciences and Social Sciences

Biotechnology

OSTP oversees the activities of the FCCSET Committee on Life Sciences and Health (CLSH). Biotechnology, a set of powerful tools originating from basic biological research, has been a major emphasis of the CLSH since it has the potential to affect virtually every aspect of life, including health, agriculture, the environment, energy production, and manufacturing. The field of biotechnology is projected to grow rapidly to become a $50 billion industry by the year 2000. The Biotechnology Research Subcommittee (BRS), a component of CLSH, has developed an inventory of Federal biotechnology research programs. Drawing on this inventory, twelve agencies represented in the BRS collaborated to formulate national goals, objectives, and strategies.

OSTP worked on the so-called "Scope" document setting forth the principles for regulation of the products of biotechnology that was published in final form in the Federal Register. FDA followed these principles in issuing its proposed Food Policy regulations. Work is progressing with the EPA in developing similar guidelines under the Toxic Substances Control Act and with the Department of Agriculture with respect to pesticides.

In the international arena, a Task Force on Biotechnology Research was established by the United States and the European Community (EC) in the fall of 1989. The goal of the task force is to increase mutual understanding of U.S. and EC activities related to biotechnology. Members discuss priorities and science policy issues, plan joint workshops, and identify ways for creating a more favorable research environment. OSTP worked with the task force throughout 1992.

Genome Patent Policy

As a result of rapid technological developments, large numbers of genomic fragments were able to be produced in laboratories of the National Institutes of Health, as well as in other laboratories in the United States and other countries. Consonant with provisions of the Stevenson-Wydler Technology Innovation Act, the Patent and Trademark Act Amendments of 1980, and the Federal Technology Transfer Act, NIH filed an application to patent these fragments.

It was recognized that the issuance of such patents -- or conversely their failure to issue -- would have significant impacts both on the advancement of science and on the commercialization of products that might stem from these or other incompletely characterized genomic sequences. Accordingly, an interagency Working Group on Genome Patenting was established in November 1991 with the responsibility of defining the pertinent issues; collecting information and perspectives from relevant government agencies and industries as well as the scientific and international communities; proposing policy options; and assessing their potential impact. As part of this effort, a public meeting was held at the National Academy of Sciences in May 1992 both to inform the public and to seek their views. The report of this Working Group is now available.

Radiation Research and Policy

The Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), another FCCSET subcommittee under CLSH, dealt with a number of important issues. Of special significance were the possible health effects related to low frequency electric and magnetic fields, a subject of substantial interest in the public press. CIRRPC, through Oak Ridge Associated Universities, established a multidisciplinary panel of nationally recognized scientists to review all available data and to compile an authoritative report. This report was published in 1992.

The National Council on Radiation Protection and Measurements was requested to undertake two important studies. The first addressed the scientific basis and utility of the collective dose concept in making decisions on radiation protection. The second is a review of the epidemiologic data associating health risks with exposures to radon.

As part of its charge to evaluate radiation research and identify research needs, CIRRPC sponsored an Internal Dosimetry Workshop to determine research deficiencies and corresponding research needs in the area of internal dosimetry. A three-day workshop was attended by representatives from national and international governments, laboratories, and universities, as well as the private sector.

The committee also coordinated interagency reviews of two comprehensive documents drafted by the U.S. Environmental Protection Agency (EPA). The first dealt with the carcinogenicity of electromagnetic fields; the second with proposed new standards limiting the concentration of radionuclides, including radon, in public drinking water. These reviews resulted in the development of CIRRPC comments that were submitted to EPA, OSTP, and OMB.

Agriculture

The Committee on Food, Agricultural, and Forestry Research under FCCSET is mandated by the Agriculture and Food Act of 1981. It is charged with reviewing federal research and development relevant to domestic and world food and fiber production and distribution, with promoting planning and coordination of research in the Federal government, and with recommending policies and other measures concerning food and agricultural sciences. During 1992, the Committee's primary concern was federally sponsored food safety research. An overview of federal food safety research was published in January 1993.

Human Risk Assessment Policies

Under an ad hoc Working Group on Risk Assessment under FCCSET, OSTP has participated in an active interagency effort under the auspices of six specialized subcommittees. An inventory of risk assessment data bases has been compiled, and mechanisms are being explored to permit their more ready access and, in some instances, consolidation. Scientific issues pertaining to non-cancer endpoints, specifically neurotoxicity and reproductive toxicity, are under study. An agreed-upon method for interpolating results between different species has been agreed upon and published in the Federal Register. Other activities relate to the validation of model systems, assumptions, and estimates to be used in pharmokinetic systems, the development of biomarkers, and methods for exposure assessment.

Protection of Human Subjects

Under the direction of CLSH, a federal policy for the protection of human subjects in research was issued in the summer of 1991 as a final common rule. This rule applies to 16 federal departments and agencies. The Human Subjects Research Committee continues to monitor implementation of the common rule and to aid in its interpretation and application.

Vaccine Research

Two vaccine research initiatives were launched in FY 1992, one pertaining to an internationally coordinated program to develop a new family of vaccines for use in children, and the second to coordinate and facilitate efficacy trials of HIV vaccines.

The Children's Vaccine Initiative, a collaborative program launched in 1990 by a group of countries and development agencies (including the World Health Organization, the United Nations Children's Fund, the United Nations Development Program, and the Rockefeller Foundation), set as a goal for the year 2000 the development of vaccines that would protect children against twenty or more diseases with not more than two injections (or feedings) administered at or soon after birth. An informal interagency planning process has been initiated to guide U.S. activities.

A Working Group on HIV Vaccine Development and International Field Trials was established in the spring of 1992 to plan a coordinated interagency program of field research. This special working group was deemed necessary because of the unique problems and challenges in testing an HIV vaccine and because of the urgency in proceeding with these studies. Because of the complexities of the issues involved, a coordinated U.S. effort in collaboration with international agencies and other governments is being developed.

Other Life Science Activities

A long-standing OSTP requested study concluded in Fiscal Year 1992. In 1984 OSTP had asked that the Air Force ascertain the health of children fathered by participants in the "Ranch Hand" study (military personnel exposed to Agent Orange). Air Force scientists gathered medical records on all pregnancies and children fathered by men in the study. After the Centers for Disease Control developed a method to measure dioxin levels in blood, this technique was used as the indicator of dioxin exposure. The Air Force determined the blood dioxin levels of 971 Ranch Hands and 942 comparison study subjects and verified the status of the 5,489 pregnancies and 4,514 live births fathered by these men. The study found no adverse relationships between dioxin and any reproductive outcomes. It is the first study to combine a direct measurement of paternal dioxin level with documented and verified pregnancy outcomes.

Working with OMB, OSTP staff also completed work on OSHA regulations intended to minimize health care workers' risk of exposure to blood-borne pathogens. The final rule was widely acclaimed.

Social Sciences

OSTP regards the social sciences as an integral part of the human intellectual frontier and as a necessary element of research directed to solving many complex scientific problems. In global change research, for example, both the impact of global change on human activities and the impact of anthropogenic activities on the Earth system are areas in which scientific uncertainties need to be addressed by social scientists in collaboration with physical and life scientists.

In Fiscal Year 1992, OSTP monitored the establishment of a new National Science Foundation (NSF) directorate for the Social, Behavioral, and Economic Sciences. Providing a directorate-level focus to those fields will enable NSF to respond effectively to new opportunities in rapidly advancing areas of social and behavioral science research.

OSTP has continued an ongoing dialogue with professional societies in the social and behavioral sciences. In 1992, as in the previous year, the Director of OSTP and his senior staff met with their Presidents and Executive Directors.

The Environment

Global Change

The United States will implement a policy process for global change issues that ensures that the best and most recent scientific information is integrated into the policy-making process in the most timely manner possible. The U.S. Climate Change Research Program, in which OSTP participates, has as its central goal "to establish the scientific basis for national and international policymaking relating to natural and human-induced changes in the global Earth system."

In Fiscal Year 1992, the Director of OSTP chaired the Global Change Strategy Task Force (STF) of the Working Group on Global Change. The STF contributed to the development and coordination of U.S. positions on global change issues in preparation for U.S. participation at international meetings. Another major activity of the STF was in-depth discussion of the policy implications of new science results for the 1991 International Assessment of Stratospheric Ozone and their impact on U.S. positions for the Montreal Protocol negotiations. OSTP will direct the activities of STF, it successors and other elements of the Working Group on Global Change, toward implementation of a strong policy on global change.

Regional Institutes on Global Change

Initial planning for an Inter-American Institute (IAI) for collaborative research on the science and economics of global change concluded early in 1992 and culminated in preparation of a draft agreement to establish the institute. The agreement was signed by eleven governments (Argentina, Bolivia, Brazil, Chile, Costa Rica, Dominican Republic, Mexico, Panama, Peru, the United States, and Uruguay) at a High-Level Meeting on May 12-13, 1992, in Montevideo, Uruguay. Venezuela also indicated its intention to sign in the near future. The Director of OSTP signed this agreement for the United States.

The Declaration of Montevideo that accompanied this Agreement called for establishment of an "Implementation Committee" (IC), which met for the first time on July 15-17, 1992, in Santo Domingo, Dominican Republic. The committee has begun planning for the first meeting of the "Conference of the Parties" for the IAI to be convened shortly after the agreement comes into force -- that is, following ratification or equivalent final approval by six countries. The IC set up three substantive working groups to further develop a scientific agenda; organizational and management positions; and procedures for budgeting and funding the IAI.

Planning for the Europe-African institute is proceeding through a coordination effort by the Commission of the European Community, which is currently proposing to its member states the setting-up of a Europe-Africa Network for Global Change Research in order to bring together, in this field of research, the critical mass of resources and capabilities of the two continents and to provide a logistical basis for managing collaboration among involved countries and international research institutions.

With regard to a regional research institute in the Asia-Pacific region, there have been a number of recent developments in the area that indicate a high level of interest. For example, the following activities were initiated: (1) Japan announced its intent to host the International Workshop on Asian-Pacific Global Environmental Research Network, (2) The Secretariat for the International Geosphere-Biosphere Programme convened a workshop in January 1992 in Thailand to develop a global change research agenda specifically for Southeast Asia, (3) Indonesia has indicated that it would be prepared to host a regional institute for the Tropical Asian Monsoon region, and (4) Thailand has indicated a similar interest in hosting a regional institute for Southeast Asia.

These regional research institutes are being closely coordinated with the Global Change System for Analysis, Research, and Training (START) established in 1991 by the International Geosphere-Biosphere Programme, the World Climate Research Program, and the Human Dimensions of Global Environmental Change Programme.

Other Environmental Issues

Through a variety of interagency groups, OSTP participated in a number of other environmental issues and activities. OSTP contributed to preparations for the UN Conference on Environment and Development (UNCED), providing information and analysis on issues such as atmospheric science, biological diversity, oceans, biotechnology, technology transfer, institutions, and capacity building. OSTP is also actively participating in follow-up activities to the UNCED through membership on interagency committees as well as through meetings in the Executive Office of the President in a number of areas such as biodiversity, climate change, country studies, and technology cooperation.

As part of its work with NASA's Earth Observing System and other earth remote sensing activities, OSTP represented the United States in London at an international meeting to discuss an initiative put forth by the United Kingdom at UNCED designed to help strengthen international coordination of earth observations among satellite missions in the areas of data handling, processing, archiving, and networking and, in particular, to build better coordination with the user community.

OSTP staff served as members of the Science Advisory Board of the statutorily mandated Strategic Environmental Research Development Program (SERDP). The purpose of SERPD is to address environmental matters of concern to the DoD and DOE that can enhance the capability of the departments to meet their environmental obligations through support for basic and applied research and development of technologies.

As part of other working groups and committees, OSTP has remained an active participant in many additional environmental issues including the Arctic, Antarctic, the Global Environmental Facility, ocean science, G-7 environmental issues, environmental problems in the Former Soviet Union, environmental data and information management, and endangered species.

International Science and Technology

OSTP plays a major role in coordinating, planning, and initiating international science and technology policy. As international science and technology activities cut across all disciplines, many such activities are discussed in other sections of this report. The focus here is on specific bilateral and multilateral agreements and issues in which OSTP has been involved.

Bilateral Science and Technology Relations

OSTP contributes to the policy context, development, and oversight of nearly 600 bilateral science and technology agreements, which remain the primary mechanism for official U.S. government participation in international science and technology activities. These agreements promote U.S. national interests overseas, enable access to science and technology developments in other countries, and further the missions of federal agencies. Each agreement seeks to ensure the adequate and effective protection of U.S. intellectual property rights (IPR), an increasingly important element in our international relations in today's global economy.

Japan continues to be an important partner in science and technology. The growing science and technology relationship between the U.S. and Japan is guided by the U.S.-Japan Science and Technology Agreement signed in 1988. The agreement is due to terminate on June 20, 1993, and OSTP has been actively engaged in discussions on its renewal. The goal is to enhance the effectiveness of the agreement through streamlined implementation. OSTP representatives have met with the Japanese Ambassador to the United States and the U.S. Ambassador to Japan to discuss renewal of the agreement. OSTP has held a number of discussions with the science counselors in Washington and Tokyo to review this as well.

OSTP has worked closely with the Department of State in planning the Joint Working Level Committee meeting at which the United States and Japan will begin developing measures to improve implementation of a renewed agreement, including a review of the Task Force and Liaison Group structure.

An important component of the science and technology agreement is the Joint High Level Advisory Panel (JHLAP). The panel is charged with advising the Joint High Level Committee, co-chaired by the Director of OSTP, on issues of importance to the overall U.S.-Japan science and technology relationship. In fulfilling this function, the panel recommends specific areas for cooperation and suggests possible mechanisms and approaches to achieving recommended objectives. As we look toward renewal of the U.S.-Japan Science and Technology Agreement, and building on the excellent work of the current Panel, OSTP is rotating membership of the JHLAP to develop a new set of perspectives in our continuing efforts to enhance science and technology cooperation between the United States and Japan.

OSTP is leading U.S. involvement with the Japanese on the Human Frontier Science Program (HFSP). The HFSP is a major Japanese-initiated R&D program in cellular and molecular biology aiming to promote, through international collaboration, basic research and communication to understand fundamental biological mechanisms of complex organisms. OSTP guides U.S. input to the HFSP through the U.S.

representatives on the Board of Trustees. The position of Secretary-General of the HFSP will become available in the spring of 1993. Through interagency consultations, OSTP has led the effort to identify a potential U.S. candidate for this important position.

Intellectual property rights remains an important issue in negotiations with Germany, France, and the European Community on bilateral science and technology agreements. While not all issues have been resolved, significant progress has been made, and negotiations continue to progress toward final agreement.

Canada and the United States enjoy a significant degree of science and technology cooperation, although the two countries do not currently have an umbrella science and technology agreement. To enhance science and technology cooperation between the U.S. and Canada, OSTP has established with the Canadian Ministry of Science a joint consultative mechanism (JCM). The JCM will be used as a forum to address a wide range of science and technology issues, including intellectual property rights, international competitiveness, and cooperation in megascience programs.

Cooperation with Mexico is a high priority. OSTP has supported enhanced cooperation by working with President Salinas' science advisor, Dr. Guillermo Soberón, to establish a Mexico-U.S. Joint Consultative Group (JCG) modeled on the E.C.-U.S. and Canada-U.S. Joint Consultative Groups already in place. A Mexico-U.S. JCG will serve to identify possible science and technology interaction points between our two countries and designate lead agencies for each important area of mutual interest. The JCG will emphasize informal dialogue, with consultations to be held once a year between the Assistant to the President for Science and Technology (for the United States) and the Coordinator General of the Consejo Consultivo de Ciencias (for Mexico).

At a June 1992 Summit, the Presidents of the United States and Russia issued a joint statement on science and technology cooperation, noting that: "The two Presidents . . . declared their intent to advance the state of science and technology by broadening and expanding contacts and combining the talents and resources of both countries." OSTP has undertaken an effort to understand better the character and magnitude of science and technology interactions between the United States and Russia. OSTP is attempting to identify the impediments that hinder science and technology interactions in an effort to reduce or eliminate barriers to greater cooperation. This includes identifying means of removing or minimizing obstacles due to inappropriate taxes, laws regulating intellectual property rights, contracts, and ownership. OSTP is building on the broad experience of the academic, business, and government communities in collaborating with Russia in science and technology. Input from these communities has been solicited primarily at two major meetings hosted by OSTP, one with representatives of societies, associations, and private foundations, the other with representatives from industry.

Multilateral Activities

In addition to its bilateral activities, OSTP is involved in a number of important multilateral science and technology initiatives. As the costs associated with science and technology rise and as the number of issues that are inherently transnational or global in character increases, multilateral approaches to science and technology inevitably will increase. OSTP has played a central role in coordinating the contributions of different federal agencies and in ensuring that science and technology interactions with foreign countries best serve U.S. interests. A primary mechanism for implementing this coordination is FCCSET's Committee on International Science, Engineering, and Technology (CISET).

CISET has produced a major report on opportunities for science and technology cooperation with Central and Eastern Europe, with significant recommendations for U.S. government approaches to science and technology in the region. CISET will provide a forum for examining a number of other critical issues, including science and technology in Russia, principles and guidelines for international science and technology, and means for removing the administrative and regulatory barriers to successful international cooperation in science, particularly in the area of megaprojects.

OSTP participation in the Organization for Economic Cooperation and Development (OECD) is another important means for coordinating multilateral science and technology activities. The Director of OSTP led the United States delegation at the March 11, 1992, Ministerial-level meeting of OECD's Committee for Scientific and Technological Policy (CSTP). The Ministerial provided an opportunity to discuss a wide range of issues in the areas of international large-scale science programs, Central and Eastern Europe, and national innovation systems.

A significant outcome of the March OECD Ministerial was, with U.S. leadership, the establishment of the Megascience Forum under the CSTP. The Forum will help ensure that large-scale international science programs are developed and managed effectively in the context of appropriate international cooperation.

In May 1992 the Director of OSTP participated in the Carnegie Group meetings at Leeds Castle in the United Kingdom. The series of Carnegie meetings, the location of which is rotated each year, has been established to provide science advisors to heads of governments an informal opportunity to discuss relevant issues in advance of heads-of-state meetings. The meeting at Leeds Castle allowed for a discussion of a wide range of pressing issues, including megascience projects, oceanographic research, release of genetically altered organisms, and support of basic research in Russia. The meeting also provided an opportunity to discuss current negotiations on bilateral science and technology agreements.

National Security

OSTP advises the President and the National Security Council (NSC) concerning the science and technology aspects of national defense, intelligence, arms control, military space programs, technology and information security, and emergency telecommunications planning. In addition, it works with OMB to review national security R&D budgets and helps coordinate the work of Executive departments and agencies in those areas.

National Security Implications of Breakup of Soviet Union

The dissolution of the Soviet Union has occasioned wide-ranging reviews of U.S. national security requirements, including demands on science and technology. In FY 1992, OSTP participated in a number of NSC-led interagency efforts to examine the near-term policy implications of the new threats and new opportunities now emerging:

- Providing support for building the institutions of democracy in the republics of the Commonwealth of Independent States (CIS).
- Assisting in the dismantlement of Soviet nuclear forces and their support infrastructure, as part of a larger effort to encourage demilitarization.
- Devising trade policies and assistance programs to help facilitate the transition to free-market economies in the CIS, while continuing necessary technology transfer controls on military and dual use technologies.
- Identifying technologies and trade opportunities of particular interest to departments and agencies of the U.S. government.
- Reviewing the work and membership of COCOM in light of the political changes in Eastern Europe and the former Soviet Union.

- Assessing the proliferation concerns that derive from new sources of supply of weapons of mass destruction, associated materials, and other high technology weapons that were built and stockpiled by the Soviet military, and devising policies and programs to discourage their transfer to third world and other customers.

- Evaluating the level and scope of unemployment among scientists and engineers in the CIS with expertise in weapons of mass destruction and their delivery systems, the prospects for their seeking employment with nations of proliferation concern (either by emigrating or through in situ contractual arrangements), and helping to create incentives for them to turn their talents to peaceful pursuits.

Intelligence Missions and Resources

The breakup of the Soviet Union, the uncertainty surrounding the future of Russia and the other republics, and the emergence of regional threats to peace also have profound implications for the intelligence resources the United States will require for our future security and national objectives. OSTP assisted the NSC in compiling long-term national intelligence requirements from all consumers in the Executive Branch looking to the year 2005. This FY 1992 study was undertaken at the President's directive and was referred to the Director of Central Intelligence for his use to assigning priorities and resources throughout the intelligence community.

OSTP has also been working with the intelligence community to help arrive at ways in which intelligence can help economic and science and technology policy making. In particular, foreign targeting of the U.S. R&D base and other private sector commercial and business data is an area of growing concern. Understanding the objectives and methods of foreign governments, and the vulnerabilities of American business and industry, is essential to safeguarding the nation's security and devising policies and programs to deal with unfair or illegal threats to America's ability to compete. Among other things, the report of OSTP's National Critical Technologies Panel is being used by the FBI to assist in its counterespionage mission.

Over the years the intelligence community has devoted a great deal of creativity and resources to developing cutting-edge technologies for intelligence collection, with impressive results. But relatively little has been invested in technology to support the analytic process or dissemination to the customer. As the intelligence community redirects its resources in response to changing requirements, it is critical to use advances in technology to support intelligence analysis. The intelligence community has made progress in several areas of exploiting information systems technologies, but it falls short in others. OSTP is working with the intelligence community to explore new avenues to effectively and efficiently upgrade the technological infrastructure for data storage, retrieval, and processing to help improve intelligence analysis.

Telecommunications

By Executive Order the Director of OSTP is assigned the responsibility for managing the nation's telecommunications resources during wartime crises and emergencies. In FY 1992 OSTP focused attention on critical tasks associated with this responsibility to maintain a high state of readiness. As Chairman of the Joint Telecommunications Resources Board (JTRB), the Director of OSTP has also prepared for resolution of telecommunication crises during non-wartime emergencies. A review was undertaken to update JTRB plans and procedures for responding to telecommunications emergencies throughout the spectrum of crises. The Director published a revised "National Plan for Telecommunications Support in Non-Wartime Emergencies" to help communications planners and managers in the government obtain required telecommunications support during crisis.

Through membership on steering groups and advisory boards, interaction with the NSC and OMB, and a working relationship with the National Communications System and its members, OSTP reviewed and coordinated proposed telecommunications programs and policies and contributed to enhancing the readiness of the federal government to respond to crises.

The Science and Technology Base

Basic Research

OSTP, at the invitation of OMB, took part in discussions with the science and technology agencies associated with the formulation of the FY 1993 research budget proposed to Congress, and aided in identifying essential elements of a strong research base for the United States. OSTP staff maintain close contact with as large a sample of the disparate scientific and engineering research communities as is feasible to keep abreast of new developments and potential problems. This involves meeting with individual scientists and engineers, representatives of their professional societies, National Academy of Sciences panels, and trade associations and addressing groups of scientists and engineers at various meetings. The activity provides the perspective we need to advise the President and others within the Executive Office of the President on issues within our purview.

OSTP also concerns itself with infrastructure issues affecting research. For example, an adequate supply of nuclear isotopes is of fundamental importance to a wide spectrum of physical and life science research projects in the United States. In addition, the timely availability of radioactive isotopes for nuclear medicine procedures is critical to health care delivery system in hospitals located throughout the United States, with over 30,000 procedures being performed daily. Responding to reports of serious shortages in the supply of both stable and radioactive isotopes and to a request from the FCCSET Committee on Life Sciences and Health, OSTP is assisting in an investigation of how these problems might be avoided in the future. We have initiated discussions to this end with the isotope producers (the Department of Energy and private sector groups), users, federal agencies, and congressional staff to ascertain the magnitude of the problem and to identify possible solutions.

Academic Research and Development

U.S. basic research, about half of which is performed at academic institutions, is the foundation of the nation's R&D enterprise. There are persistent signs that the majority of our key universities are under serious financial stress and that the relationship between academic institutions and the federal government is fraying. Among the factors affecting the health of universities are the short- and long-term constraints in public funding at the federal and state levels. In an era of constrained budgets, effective returns on investments in science and technology require strategic choices based not only on the setting of broad priorities but on the support of research that meets the highest standards of quality. Broad priorities are arrived at through the political process, involving the Administration and Congress. Excellence, however, can only be judged by the process of merit review by experts who are at the forefront of scientific and technical knowledge. OSTP, in collaboration with the President's Council of Advisors on Science and Technology, reported on many of those issues late in 1992 in a publication entitled, Renewing the Promise: Research Intensive Universities and the Nation.

OSTP continues to be deeply concerned by the growing phenomenon of Congressional earmarking of R&D projects and facilities. To monitor that phenomenon, OSTP reported in early 1992 the results of its survey of R&D earmarking contained in the FY 1992 appropriations. It found that total R&D earmarking was nearly $1 billion (more than 20 percent greater than the previous year), an amount of funding that could have a much more significant impact if invested in more meritorious projects and programs.

During the past year, considerable controversy has also surrounded the issue of what kinds and magnitude of overhead costs are appropriate for research projects carried out by educational institutions under the sponsorship of agencies of the federal government. In response to these concerns and with a view to both strengthening and simplifying the indirect-cost system, OMB and OSTP jointly established an interagency task force to develop revisions to the principal guidance document -- OMB Circular A-21. Two OSTP staff, who serve as Vice-Chairman and Executive Secretary, respectively, have had primary responsibility for identifying and analyzing relevant options for changes in the circular. The OSTP staff also have served as the primary liaisons to the university community with respect to these issues.

In response to a Congressional request in the American Technology Preeminence Act, OSTP issued a report in August 1992 on a "Strategy to Stimulate Competitive Research in Selected States." That report examined the distribution of federal R&D funding relative to the (state-by-state) distribution of population and various federal programs designed to broaden the distribution of funds. The report notes that broadening the research infrastructure can promote local economic development and increase the young talent pool of future scientists and engineers.

During Fiscal Year 1992, the Director of OSTP initiated studies to identify and assess problems affecting research-intensive universities and to develop appropriate corrective public policy responses. The reviews were published in late 1992.

Scientific and Technical Information

Vast quantities of scientific and technical information (STI) result from the more than $70 billion spent each year on federal R&D. This includes many types of information, ranging from raw research data to scientific papers, contained in many types of media, from paper text to electronic images. Such information has enormous value, well beyond the original mission that caused it to be generated, for further research, technological development in industry and agriculture, education, public health, and other uses by the public.

The management of and access to federal information, in general, is guided by generic policies not specific to STI. Coordination is needed to ensure that STI collection, management, and dissemination efforts are not duplicated, and to enhance the return on the federal R&D investment by improving the efficiency and effectiveness of STI dissemination. Accordingly, the Director of OSTP, as Chairman of FCCSET, established an Ad Hoc Working Group on STI. Its work is just getting underway.

Mathematics and Science Education

OSTP established the Committee on Education and Human Resources (CEHR) through the FCCSET process to promote improvements in mathematics and science achievement. In its first two years of operation, CEHR developed, for the first time, a comprehensive baseline inventory of federal funding and programs that affect mathematics and science education at all levels, and a set of strategic priorities to guide future federal actions in this area.

OSTP worked with the Strategic Plan Working Group, the Budget Working Group, and all seven of the working subgroups of the CEHR to develop the integrated cross-agency strategic plan and related budget submission. As a result, there has been a significant and noteworthy increase in the degree of interagency coordination in mathematics and science education.

OSTP worked with CEHR agencies in designing and carrying out a national workshop on educational technologies, which fulfilled a commitment regarding educational technologies. The workshop extended prior planning, research, and policy efforts on the role of telecommunications in education by providing a forum for current reports on activities in the field. Thirty-one presentations were made at the workshop to a panel of experts, to representatives of federal agencies, and to other interested persons. The report of the panel of experts provides valuable input into policy development.

OSTP has worked closely with other EOP offices on matters of policy significance in math and science education. For example, OSTP cooperated with the Office of Policy Development by providing program components for briefings with external groups regarding the Administration's programs and priorities for mathematics and science education.

OSTP has responded to Congressional queries about agency programs and about CEHR coordination activities. These interactions are extensive and range from informal responses to inquiries from individual staff through formal responses to legislation, congressional reports, and inquiries.

OSTP also meets with individuals and groups seeking information and interaction with EOP and with federal agency activities. These interactions are substantial, ranging from telephone conversations and meetings with individuals to informal meetings with groups to formal briefings. This is a major aspect of dissemination of information regarding administration programs and priorities.

ACCOMPLISHMENTS OF THE FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY

The Federal Coordinating Council for Science, Engineering, and Technology was created in 1976 by P.L. 94-282 and reestablished in 1978 by Executive Order 12039 to address high-priority science and technology policy issues that cut across the missions of more than one federal agency. It is chaired by the Director of the Office of Science and Technology Policy, and its members include the Cabinet Secretaries or Deputy Secretaries and the Directors or Administrators of the departments and independent agencies involved with science and technology. During the last year, membership in the full FCCSET has expanded to include the General Services Administration, the Nuclear Regulatory Commission, and the Central Intelligence Agency.

The full FCCSET met on a bimonthly basis in FY 1992, much more often than in previous years, reflecting the number and importance of activities ongoing under FCCSET. Also, for the first time, the chairmen and vice chairmen of FCCSET committees met bimonthly in planning sessions preceding the full FCCSET meetings to discuss the FCCSET agendas. Additional meetings of points of contact and committee Executive Secretaries further strengthened the preparation of FCCSET agendas, issue papers, and other procedural and policy issues.

The charters for all of the committees under FCCSET are current. Charters were developed for subcommittees and Statements of Rules and Objectives (SRO's) were established for working groups, allowing the committees and working groups much greater uniformity in their objectives.

During FY 1992 the full FCCSET oversaw the preparation of five special initiatives for the FY 1993 budget. Each of these initiatives included a coordinated interagency research and education program developed in close cooperation with OMB. The FY 1993 intiatives were: Global Change Research, High Performance Computing and Communications, Advanced Materials and Processing, Biotechnology Research, and Mathematics and Science Education.

Proposed topics for interagency budget coordination come from many sources: FCCSET members, FCCSET committees, and Executive Office of the President staff. Final selection is made in consultations between the Director of OMB and the Chairman of FCCSET. Responsibility for developing coordinated programmatic and budgetary options and recommendations is assigned to FCCSET committees, and the products, schedules, and deliverables are specified in Terms of Reference issued by OMB. Guidance is provided by the Chairman of FCCSET.

One measure of FCCSET's accomplishments is the number of departments and agencies that are participating in each budget crosscut or National Research Program (a categorization applied to mature budget crosscuts, also referred to as Presidential Initiatives). Sixteen FCCSET departments and independent agencies are participating in one or more of the five crosscuts for FY 1993. Seven members of the full FCCSET are participating in all the FY 1993 activities: DOD, DOC, DOE, HHS, NASA, EPA, and NSF.

Another measure of accomplishment is the support from Congress and the scientific community for the Presidential Initiatives that resulted from the crosscuts. Because of the severe budgetary constraints that affect federal spending, it may not be possible to fully fund the recommended programs, but it is likely that they have received more support in the aggregate that they might have done as uncoordinated individual agency submissions.

—PORTIONS DELETED BY DR. GIBBONS 3/7/93—

The Clinton Administration believes that investing in science and technology is investing in America's future: a growing economy with more high-skill, high-wage jobs for American workers; a cleaner environment where energy efficiency increases profits and reduces pollution; a stronger, more competitive private sector able to maintain U.S. leadership in critical world markets; an educational system where every student is challenged; and an inspired scientific and technological research community focused on ensuring not just our national security but our very quality of life. The most important measure of success will be our ability to make a difference in the lives of the American people, to harness science and technology so that they improve the quality of life and the economic strength of our nation.

OSTP supports these objectives by: providing authoritative scientific and technological information, analysis, and advice for the President, for the Executive Branch, and for Congress; participating in the formulation, coordination, and implementation of national and international policies and programs that involve science and technology; maintaining and promoting the health and vitality of the U.S. science and technology infrastructure; and coordinating research and development efforts of the Federal government to maximize the return on the public's investment in science and technology and to ensure that resources are used efficiently and appropriately.

ACCOMPLISHMENTS OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

The Office of Science and Technology Policy (OSTP) is an independent agency created by the Congress in 1976 within the Executive Office of the President. The Director of OSTP, John H. Gibbons, also serves as Assistant to the President for Science and Technology. The enabling legislation authorizes four Presidentially-appointed and Senate-confirmed Associate Directors with responsibilities assigned by the Director in consultation with the President.

APPENDIX A

DEPARTMENTS AND AGENCIES REPRESENTED ON THE FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY (FCCSET)

Department of State
Department of Defense
Department of the Interior
Department of Agriculture
Department of Commerce
Department of Labor
Department of Health and Human Services
Department of Housing and Urban Development
Department of Transportation
Department of Energy
Department of Education
Department of Veterans Affairs
Office of Management and Budget
National Security Council
Central Intelligence Agency
Office of Science and Technology Policy (Chair)
Environmental Protection Agency
National Aeronautics and Space Administration
Nuclear Regulatory Commission
General Services Administration
National Science Foundation

FY 1992 COMMITTEES AND AD HOC WORKING GROUPS OF FCCSET

Committee on Earth and Environmental Sciences (CEES)
Committee on Education and Human Resources (CEHR)
Committee on Food, Agriculture and Forestry Research (CFAFR)
Committee on International Science, Engineering, and Technology (CISET)
Committee on Life Sciences and Health (CLSH)
Committee on Physical, Mathematical, and Engineering Sciences (CPMES)
Committee on Industry and Technology (CIT)
Ad Hoc Working Group on Risk Assessment
Ad Hoc Working Group on Scientific Misconduct
Ad Hoc Working Group on Scientific and Technical Information

Congressman Esteban E. Torres

QUESTION

1) "One of the issues in the federal budget that concerns me is the duplication of effort, which results in a competition between federal agencies for funding for identical or for very similar programs.

"I am curious about the technology initiative identified in your statement today, as **Energy Efficiency Investment in Federal Buildings.** Doesn't the Environmental Protection Agency (EPA) have a similar program as part of their **Green Programs**, the budget of which was recently increased from $8 million to $31 million in FY93? And, isn't the EPA program in addition to the program at the Department of Energy (DOE) which is also specifically related to federal building energy efficiency? What other federal agencies are involved in building efficiency, either federal or commercial buildings? What effort is being made to coordinate these programs?

"I see a great opportunity for the federal government to prevent pollution and conservation energy, but I also see and enormous opportunity here for waste. I personally don't see the point of two, three or four federal agencies involved in the same issue, especially if they are not working together and are competing for limited resources.

ANSWER

The program for Energy Efficiency Investments in Public Buildings does not duplicate an existing program. Our new program is designed to increase the energy efficiency of federally owned buildings. Many of these buildings are far less energy efficient than privately owned structures. Taxpayers' money is being wasted as a result.

Federal building retrofit programs have been underway for some time but the programs are funded at such a low level that it will take decades to bring the inventory up to cost-effective standards. Our new program will ensure that taxpayers begin to enjoy savings much more quickly. A number of different federal agencies will be involved in the project. We will use an existing interagency coordinating program chaired by the Department of Energy to ensure consistency among agencies.

None of these programs overlap the EPA "green lights" or other "green programs". These programs are designed to encourage investment in energy efficient technologies. The program provides information and publicity for participants but no capital for investments.

Congressman Esteban E. Torres

QUESTION

2) "Following up on a question that my Chairman, Mr. Stokes, asked, I understand that this budget will allow you to increase the number of permanent staff at your agency. And, specifically, the agency will increase the number of SES employees from 4 to 8, and the number of GS-15 staff from 4 to 14. At the same time, the budget explanation identifies an expenditure of $140,000 for consultant services to do the type of analysis formerly done by detailees from other federal agencies. Wouldn't it make sense, to decrease the number of senior managers and increase the number of mid-level employees rather than contract out projects to be managed by the new senior level employees?

ANSWER

Although the number of individuals on OSTP's payroll will increase under our proposed budget and the President's staffing instructions, the actual number of individuals available to do the work formerly handled by OSTP, the National Space Council, and the National Critical Materials Council has decreased almost by half. Because of the subject areas covered by OSTP and our responsibility for coordinating policy across the Executive Branch, we must hire highly educated, experienced individuals who command high salaries. The funds allocated to consultant services will enable us to acquire very technical, very specialized information quickly, which cannot always be accomplished within even a very expert staff. I believe the staffing scheme we have developed is optimum for OSTP.

QUESTION

3) The State of California has a requirement that a percentage of automobiles offered for sale in the state must have zero emissions, i.e., electric, vehicles beginning in 1998. The "big three" auto makers have been moving very slowly toward development of an electric vehicle. In fact, two months ago, Chrysler announced it was no longer pushing ahead with its electric vehicle for availability in 1995 but would delay it several years. The President's "Clean car" initiative will involve these automakers. By what means will your office be able to bring the heretofore reluctant manufacturers to the table?

As you are no doubt aware, the California based consortium, CALSTART, is actively involved in the development of component parts for electric vehicles. Most of the participants in CALSTART are small high technology firms. Much of the innovation taking place today is by smaller firms, who are not constrained by corporate bureaucracy or dogma. What opportunity will CALSTART have to participate in the clean car task force?

Congressman Esteban E. Torres

ANSWER

We are confident our new initiative can stimulate new research, investment, and employment opportunities by all U.S. automobile businesses -- including the industry's suppliers. The federal government can offer research assistance to the industry in ways that encourage rapid innovation in both products and production processes. It can use its purchasing power and regulatory authority to encourage innovative vehicle types. A successful program would help foster a prosperous industry producing automobiles that the United States and international markets want, that are environmentally superior, and that use fuels that are abundant and secure.

It is our intention to work with all U.S. automobile companies as well as many of their suppliers. Many of these suppliers are, of course, small businesses. We haven't completed a program plan and can't be specific about how we will approach different groups.

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